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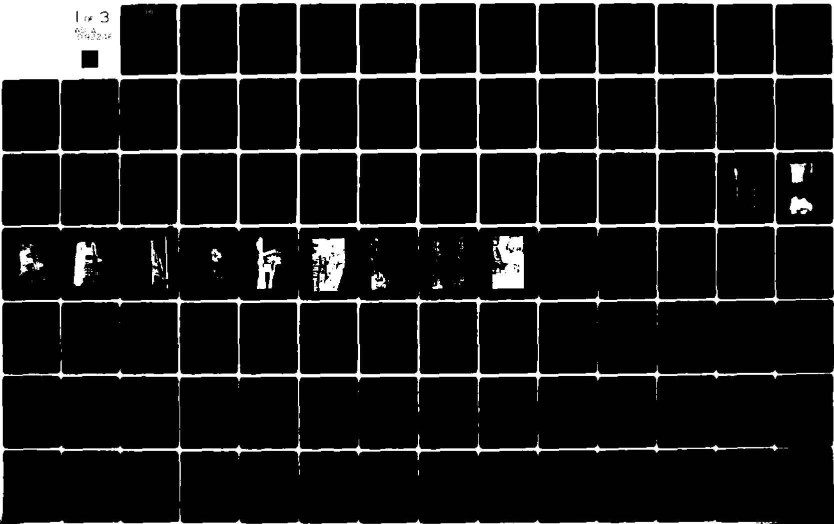

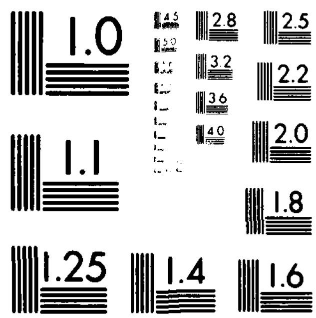

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DTNSRDC/SPD-0833-04

LEVEL II (12)

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Bethesda, Maryland 20084

AD A092246

ANALYSIS OF WAKE SURVEY EXPERIMENTAL DATA FOR MODEL 5365 REPRESENTING THE R/V ATHENA IN THE DTNSRDC TOWING TANK

by

Rae B. Hurwitz

and

L. Bruce Crook

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

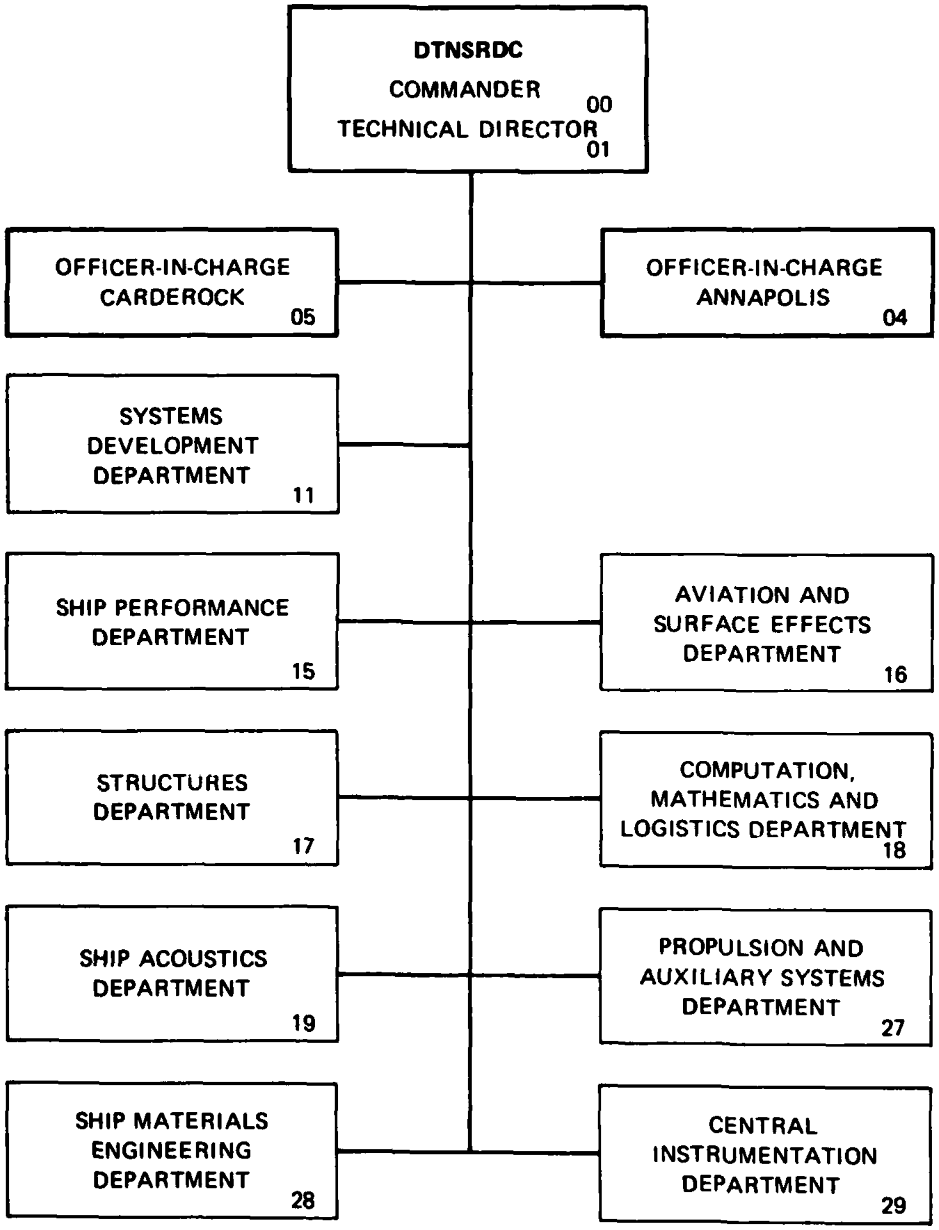
SHIP PERFORMANCE DEPARTMENT REPORT

October 1980 DTNSRDC/SPD-0833-04

ANALYSIS OF WAKE SURVEY EXPERIMENTAL DATA FOR MODEL 5365 REPRESENTING THE R/V ATHENA IN THE DTNSRDC TOWING TANK

DTNSRDC 5602/30 (2-80)
(supersedes 3960/46)

MAJOR DTNSRDC ORGANIZATIONAL COMPONENTS



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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER (14) DTNSRDC/SPD-0833-04	2. GOVT ACCESSION NO. AD-A093 246	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) (6) ANALYSIS OF WAKE SURVEY EXPERIMENTAL DATA FOR MODEL 5365 REPRESENTING THE R/V ATHENA IN THE DTNSRDC TOWING TANK		5. TYPE OF REPORT & PERIOD COVERED (9) FINAL repts
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) (10) Rae B. Hurwitz and L. Bruce Crook		8. CONTRACT OR GRANT NUMBER(s) (12)
9. PERFORMING ORGANIZATION NAME AND ADDRESS David W. Taylor Naval Ship R&D Center Ship Performance Department Bethesda, MD 20084		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS (17) ~~Task Area~~ S0379001 Work Unit 1524-641 1524-684
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Sea Systems Command (NAVSEA 05R) Washington DC 20362	(11)	12. REPORT DATE October 1980
		13. NUMBER OF PAGES 212 + XX
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) (16) S0379		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMTED

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Wake survey
Shallow Water
R/V Athena
Model 5365

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A series of wake survey experiments were conducted on Model 5365 representing the R/V ATHENA in the DTNSRDC towing tank. Longitudinal, tangential, and radial velocity components for experiments at model speeds of 2.87 knots (1.48 m/s), 5.22 knots (2.68 m/s), 6.96 knots (3.58 m/s), and 13.5 knots (6.94 m/s) are presented. Several comparisons are made between wake surveys with different water depths, trims, and speeds. A comparison of full-scale and model-scale towing tank wake survey measurements is also presented. Harmonic analyses of the circumferential distribution of the velocity component ratios

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were performed on the model experimental data and the results are reported herein.

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NOTATION

CONVENTIONAL SYMBOL	SYMBOL APPEARING ON PLOTS	DEFINITION
A_N	COS COEF	The cosine coefficient of the N^{th} harmonic*
B_N	SIN COEF	The sine coefficient of the N^{th} harmonic*
C	C	Pressure reading at center hole of 5-hole pitot tube
D	---	Propeller diameter
J_V	J_V	Apparent advance coefficient $J_V = \frac{V}{nD}$ (dimensionless)
N	N	Harmonic number
n	---	Propeller revolutions
P	P	Pressure
r/R or x	Radius or RAD.	Distance (r) from the propeller axis expressed as a ratio of the propeller radius (R)
R_n	R_n	Reynolds number
R1, R2	R1, R2	Pressure reading at radial holes of 5-hole pitot tube
T1, T2	T1, T2	Pressure reading at tangential holes of 5-hole pitot tube
U/U_∞	U/U_∞	Non-dimensional longitudinal velocity measured by means of boundary layer pitot tubes
V	V	Actual model or ship velocity
$V_b(x,\theta)$	---	Resultant inflow velocity to blade for a given point
$\overline{V}_b(x)$	---	Mean resultant inflow velocity to blade for a given radius
$V_r(x,\theta)$	VR	Radial component of the fluid velocity for a given point (positive toward the shaft centerline)

(*see footnote on page xviii)

NOTATION (CONTINUED)

CONVENTIONAL SYMBOL	SYMBOL APPEARING ON PLOTS	DEFINITION
$\bar{V}_r(x)$	---	Mean radial velocity component for a given radius
$V_r(x,\theta)/V$	VR/V	Radial velocity component ratio for a given point
$\bar{V}_r(x)/V$	VRBAR	Mean radial velocity component ratio for a given radius
$V_t(x,\theta)$	VT	Tangential component of the fluid velocity for a given point (positive in a counterclockwise direction looking forward)
$\bar{V}_t(x)$	---	Mean tangential velocity component for a given radius
$V_t(x,\theta)/V$	VT/V	Tangential velocity component ratio for a given point
$\bar{V}_t(x)/V$	VTBAR	Mean tangential velocity component ratio for a given radius
$(\tilde{V}_t(x)/V)_N$	AMPLITUDE	Amplitude (B_N for single screw symmetric; C_N otherwise) of Nth harmonic of the tangential velocity component ratio for a given radius*
$V_x(x,\theta)$	VX	Longitudinal (normal to the plane of survey) component of the fluid velocity for a given point (positive in the astern direction)
$\bar{V}_x(x)$	---	Mean longitudinal velocity component for a given radius
$V_x(x,\theta)/V$	VX/V	Longitudinal velocity component ratio for a given point
$V_x(x)/V$	VXBAR	Mean longitudinal velocity component ratio for a given radius
$(\tilde{V}_x(x)/V)_N$	AMPLITUDE	Amplitude (A_N for single screw symmetric; C_N otherwise) of Nth harmonic of the longitudinal velocity component ratio for a given radius*

NOTATION (CONTINUED)

CONVENTIONAL SYMBOL	SYMBOL APPEARING ON PLOTS	DEFINITION
x/L_{WL}	x/L_{WL}	Non-dimensional longitudinal location of boundary layer pitot tubes
ϕ_N	PHASE ANGLE	Phase angle of Nth harmonic*

*The harmonic amplitudes of any circumferential velocity distribution $f(\theta)$ are the coefficients of the Fourier Series:

$$f(\theta) = A_o + \sum_{N=1}^{N} A_N \cos(N\theta) + \sum_{N=1}^{N} B_N \sin(N\theta)$$
$$= A_o + \sum_{N=1}^{N} C_N \sin(N\theta + \phi_N)$$

NOTATION (CONTINUED)

CONVENTIONAL SYMBOL	SYMBOL APPEARING ON PLOTS	DEFINITION
$1-w(x)$	1-WX	Volumetric mean velocity ratio from the hub to a given radius

$$1-w(r/R) = \left[\frac{2 \cdot \int_{r_{hub}/R}^{r/R} (\bar{V}_{x_c}(x)/V) \cdot x \cdot dx}{(r/R)^2 - (r_{hub}/R)^2} \right]$$

where $\bar{V}_{x_c}(x)/V = \int_0^{2\pi} \left[\frac{V_{x_c}(x,\theta)}{2\pi V} \right] d\theta$

and $V_{x_c}(x,\theta)/V = (V_x(x,\theta)/V) - (V_t(x,\theta)/V) \tan(\beta(x,\theta))$

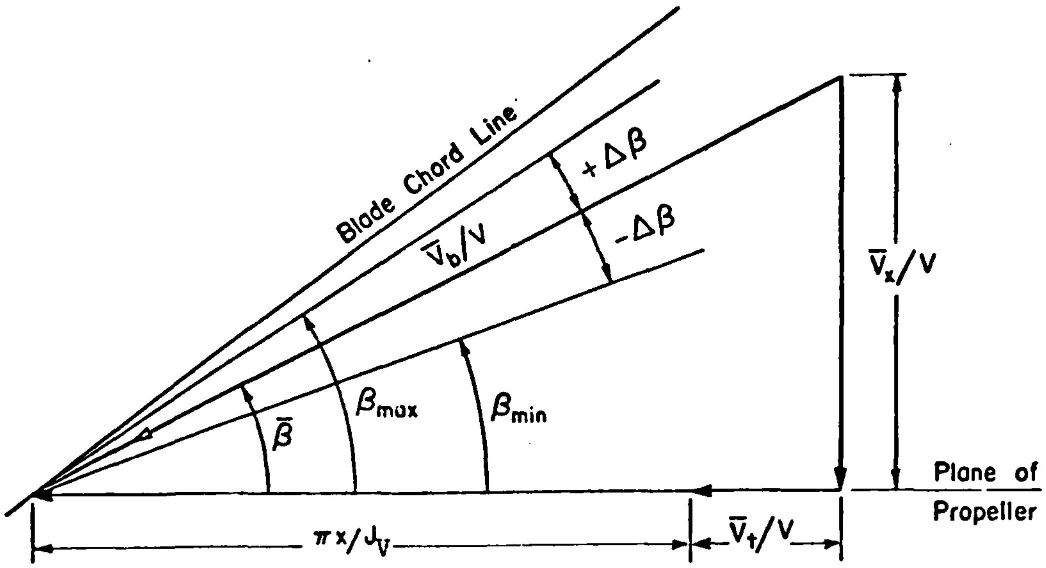
CONVENTIONAL SYMBOL	SYMBOL APPEARING ON PLOTS	DEFINITION
$1-w_v(x)$	1-WVX	Volumetric mean velocity ratio from the hub to a given radius (without the tangential velocity correction)

$$1-w(r/R) = \left[\frac{2 \cdot \int_{r_{hub}/R}^{r/R} (\bar{V}_x(x)/V) \cdot x \cdot dx}{(r/R)^2 - (r_{hub}/R)^2} \right]$$

CONVENTIONAL SYMBOL	SYMBOL APPEARING ON PLOTS	DEFINITION
$\beta(x,\theta)$	---	Advance angle in degrees for a given point
$\bar{\beta}(x)$	BBAR	Mean advance angle in degrees for a given radius
$+\Delta\beta$	BPOS	Variation of the maximum advance angle from the mean for a given radius

NOTATION (CONTINUED)

$-\Delta\beta$	BNEG	Variation of the minimum advance angle from the mean for a given radius
θ	Angle in degrees	Position angle (angular coordinate) in degrees



VELOCITY DIAGRAM OF BETA ANGLES

ENGLISH/SI EQUIVALENTS

ENGLISH	SI
1 inch	25.400 millimetres [0.0254 m (metres)]
1 foot	0.3048 m (metres)
1 foot per second	0.3048 m/sec (metres per second)
1 knot	0.5144 m/sec (metres per second)
1 degree (angle)	0.01745 rad (radians)
1 inch Water (60°F)	248.8 pa (pascals)

ABSTRACT

A series of wake survey experiments were conducted on Model 5365 representing the R/V ATHENA in the DTNSRDC towing tank. Longitudinal, tangential, and radial velocity components for experiments at model speeds of 2.87 knots (1.48 m/s), 5.22 knots (2.68 m/s), 6.96 knots (3.58 m/s), and 13.5 knots (6.94 m/s) are presented. Several comparisons are made between wake surveys with different water depths, trims, and speeds. A comparison between full-scale and model-scale towing tank wake survey measurements is also presented. Harmonic analyses of the circumferential distribution of the velocity component ratios were performed on the model experimental data and the results are reported herein.

ADMINISTRATIVE INFORMATION

This work was performed under the Controllable Pitch Propeller Research Program sponsored by the Naval Sea Systems Command (NAVSEA 05R) and administered by the David W. Taylor Naval Ship R&D Center (DTNSRDC). The project was funded under Task Area S0379001 and DTNSRDC Work Unit Numbers 1524-641 and 1524-684.

INTRODUCTION

The David W. Taylor Naval Ship R&D Center (DTNSRDC) conducted a full-scale wake survey aboard the R/V ATHENA as part of its overall project to adapt controllable pitch propellers to high speed combatant ships. The primary project goal was to obtain propeller disk velocity component ratios in the wake of a full-scale ship. A description of the R/V ATHENA full-scale measurements, instrumentation, trial procedures, and measured data was presented by Day et al.[1] The full-scale propeller disk measurements were followed by model wake survey experiments in a wind tunnel and a towing tank. The wind tunnel experiments and correlation with full-scale measurements were presented by Hurwitz and Jenkins.[2]

A series of wake surveys were conducted on Model 5365 representing the R/V ATHENA in the towing tank at DTNSRDC. The velocity component

[1] References are listed on page 13.

ratios were measured at radii corresponding exactly to the full-scale wake survey radii, allowing a direct one-to-one comparison between model and full-scale data. These experiments were designed to evaluate the differences in the model wake in the starboard propeller plane with and without the port propeller operating. The initial wake survey was conducted at a model speed corresponding to the Froude-scaled speed of the ship without the operating propeller. The model propeller was removed from the shafting and replaced by a dummy hub during the wake surveys. The initial model correlation data with the R/V ATHENA data were not particularly good. Additional wake surveys were run to try to improve the model correlation by varying the speed with and without the port propeller operating.

The effects of Reynolds number were investigated on the model-scale wake by running at an increased speed. The speed chosen was the highest speed for which steady data could be obtained. These variations made no significant improvement in the correlation of the tangential velocity components.

In addition, wake surveys were conducted with and without the Bass Dynamometer Boat, Model 5271, mounted behind Model 5365. This information was needed for the Bass Dynamometer Boat effect on the flow into the propeller disk area. The results of these Bass Dynamometer Boat wake surveys will be presented in a future report.

Finally, in an attempt to further improve the correlation of model- and full-scale data, another group of experiments was run to investigate the water depth and trim effects on the R/V ATHENA. These wake surveys were conducted in deep water, and at a water depth scaled to the full-scale trial water depth. The term shallow water will be used only to differentiate between the scaled water depth and the normal (deep) water depth used experimentally in this report. Shallow water can change the wave system due to the model and possibly affect the flow pattern around the model hull.

The results of the model wake survey conducted on Model 5365 representing the R/V ATHENA in deep and shallow water are also presented in this report. Comparisons are made between the shallow and deep water wake surveys with different speeds and trims. Full-scale data are presented as a comparison with the data obtained from the towing tank

experiments.

DESCRIPTION OF MODEL AND INSTRUMENTATION

Model 5365, representing the R/V ATHENA, was constructed of fiberglass having a scale ratio of one to 8.25. The model principal dimensions are listed with the ship dimensions in Table 1. During the wake survey experiments, the model was appended with shafts, main Vee-struts, roll stabilizer fins, and a centerline skeg. Model rudders were not installed during the first group of experiments. Figure 1 shows the body plan and bow and stern profiles of the model.

The full-scale parameters for the model experiments were at a displacement of 263 tons (267 metric ton) salt water and a mean draft of 5.63 feet (1.72 meters). The velocity surveys were conducted in the propeller plane located 146.2 feet (44.56 meters) aft of the forward perpendicular on the starboard shaft. Figure 2 shows a drawing of the Controllable Pitch Propeller.

The full-scale propeller disk was six feet (1.83 meters) in diameter. The radii at which the measurements were made were expressed as ratios of the propeller radius (r/R), and were 0.456, 0.633, 0.781, and 0.963 as shown in Figure 3. The model details during the deep water wake survey experiments are shown in Figures 4 through 7. The photographs indicate the relationship of the pitot tube rake, in the propeller plane, to the hull and its appendages for these wake surveys.

Figures 8 through 10 present the model details for the shallow water wake surveys. During these experiments, Model 5365 was appended with the port rudder and starboard strut barrel extension to better represent the R/V ATHENA configuration. Wave profiles for a ship speed corresponding to 15 knots (7.72 m/s) full-scale in shallow and deep water from Experiments 19 and 21 are shown in Figures 11 through 14.

The shape of the pitot tube rake was such that the rake could possibly change the hull trim or heel while the model was towed. In order to insure the proper trim throughout an individual or group of similar experiments, the model was locked into either a deep water trim as in Experiments 1 through 12, or the shallow water trim for Experiments 17 through 22.

The model wake measurement system consisted of the rake, a set of four differential pressure gages, a stepping motor, and an angle indicator. Experiments 1 through 16 had one set of gages and Experiments 17 through 22 had two sets. The base pressure for each tube was the center hole. A description of the use and calibration of five-hole pitot tubes is given by Hadler and Cheng[3], Hale and Norris[4], and Pien[5]. The carriage computer integrated, over a 5-second period, the four pressure signals from each pitot tube, the model speed, and the angular rake position. Digital voltmeters and frequency counters were used to monitor the values obtained by the computer. The pressure data were collected and processed according to established procedures.

The first phase of the data analysis consists of changing the pressure data into velocity component ratios. The velocity component ratios are double interpolated in both the radial and circumferential directions. This process yields interpolated data at every 2.5 degrees (0.044 radian) for the experimental radii and any additional selected radii. The second phase consists of a harmonic analysis of these interpolated data which determines a Fourier Series, with the results presented as amplitudes and phase angles of a sine series.

EXPERIMENTS

The experimental program consisted of a series of twenty-two experiments in deep and shallow water performed in two phases. Phase one wake measurements were made on the starboard shaft with and without the port propeller operating. These included Experiments 1 through 16 which were conducted in deep water at the static initial trim of 0.58 feet (0.18 meters) full-scale by the stern without rudders fitted to the model. The calibration of the pressure gages and a check-out of the entire measurement system was Experiment 1. Experiments 2, 3, 4, 5, 6, 8, 9, and 10 were deep water wake survey experiments for model speeds of 2.87 knots (1.48 m/s), 5.22 knots (2.68 m/s), 6.96 knots (3.58 m/s), and 13.5 knots (6.94 m/s). Experiment 7 was a short check of values obtained in Experiment 2. Wake survey experiments conducted with the bass dynamometer boat and Model 5365 with a wake screen at various inclined angles were designated Experiments 11 through 16. The results from Experiments 10 through 16

will be presented in a separate report.

In phase two, Experiments 17 through 22 were performed with the model ballasted to a static initial trim of 0.58 feet (0.18 meters) full-scale by the stern. The model was then run in shallow water at the desired speed, allowed to assume a shallow water running trim, and locked in place at this shallow water trim. Experiment 17 consisted of the calibration of the pressure gages and Experiment 18 was a shallow and deep water wake survey for four radii at twenty degree (0.349 radian) increments around the propeller disk. Experiments 20 and 22 were run in deep water only for two radii for a full disk and twenty degree (0.349 radian) increments, respectively. Experiment 19 was a wake survey in deep water at the shallow water trim setting and Experiment 21 was a wake survey in shallow water at the shallow water trim setting. Table 2 presents the experimental program with notes identifying each specific wake survey experiment. Variations in model speed, trim setting, with or without port propeller, and water depth for each experiment are included in this table.

PRESENTATION OF RESULTS OF VELOCITY SURVEYS

PHASE ONE - EXPERIMENTS 2, 3, 4, 5, 6, 7, 8, AND 9

The velocity component ratios were measured at radii corresponding exactly to the full-scale wake survey on the R/V ATHENA. This allowed a direct one-to-one comparison of the data as presented in Reed and Day[6]. Experiments 2, 7, and 8 were performed at a 5.22 knot (2.68 m/s) speed, corresponding to a Froude-scaled speed of 15 knots (7.72 m/s) full-scale. Experiments 2 and 7 were performed without the port propeller. Experiment 7 was an abbreviated repeat of Experiment 2. Experiment 3 was performed without the operating port propeller.

Appendices A and F present the velocity component ratios from Experiments 2, 7, and 8. Composite plots have been produced which show Experiments 2 and 8, along with the full-scale data on one grid. These composite plots presented in Figures 15 through 18 show the effect of the operating propeller on the velocity components for the four experimental radii.

Experiment 3 was conducted at a model speed of 6.96 knots (3.58 m/s) without the port propeller. Experiment 9 was a check of Experiment 3 with

data obtained at least every 45 degrees (0.785 radians). The results of Experiments 3 and 9 are shown in Appendix B.

Experiment 4 investigated the effect of Reynolds number on the model wake. This wake survey was run at a speed of 13.5 knots (6.94 m/s) without the port propeller. This was the highest speed for which steady state data could be obtained. The trim was locked at the running trim assumed at the 5.22 knot (2.68 m/s) speed. This experiment also investigated the scaling laws of wake as close to full-scale conditions as possible. The data from this wake survey, Experiment 4, are presented in Appendix C. The velocity component ratios from Experiment 2 at 5.22 knots (2.68 m/s) and Experiment 4 at 13.5 knots (6.94 m/s) have been plotted together and are presented in Figures 21 through 24.

Wake survey Experiments 5 and 6 were run at a model speed of 2.87 knots (1.48 m/s) with and without the port propeller operating. Appendices D and E present the data for Experiments 5 and 6, respectively.

Harmonic analyses have been performed on the longitudinal and tangential velocity component ratios for the experiments of phase one. Figures 19, 20, 25, and 26 have been prepared as composites which show the results of Experiments 2 and 8, and 2 and 4. Tables of the individual harmonic amplitudes and phase angles are presented in Appendices A, B, C, D, E, and F for Experiments 2 and 7, 3 and 9, 4, 5, 6, and 8, respectively. In each of these appendices, the complete set of sixteen harmonics calculated for each experiment are presented for the four experimental radii and eight interpolated radii.

The mean longitudinal (VXBAR), tangential (VTBAR), radial (VRBAR) component ratios of the velocity vectors, and the volumetric mean wake velocity ratio (1-WX) are presented in each Appendix. These quantities except the radial component (VRBAR) are also shown graphically in each Appendix.

The calculated mean values of the advance angle (BBAR), and the maximum variations thereof (BPOS) and (BNEG) are shown in tables and figures plotted as a function of radius in the Appendices. The advance angles were calculated using an advance coefficient, J_V, of 0.739. A diagram showing the relationship between the longitudinal and tangential

velocity vectors, the advance coefficient, and the advance angles is presented on page xx.

PHASE TWO - EXPERIMENTS 19 AND 21

Wake survey experiments were conducted in shallow and deep water at the shallow water trim setting. Experiments 19 and 21 were run from west to east on Carriage One at a model speed of 5.22 knots (2.68 m/s) with the propeller operating. The R/V ATHENA trial depth of 55.7 feet (17.0 meters) was determined from a Coast and Geodetic Survey Chart and could be considered less than "deep water." The corresponding model-scale water depth was 6.75 feet (2.06 meters). The data from Experiments 19 in deep water and 21 in shallow water are presented in Appendices G and H, respectively. Experiment 21 data have an integration time of one second at three locations in the shallow water basin. These points were at 90 feet (27.4 meters), 60 feet (18.3 meters), and 30 feet (9.14 meters) from the end of the shallow water basin. The data from Experiments 8, 19, and 21 have been plotted together in Figures 27 through 30 to show the effects of shallow water and shallow water trim.

Harmonic analyses of the circumferential distribution of the longitudinal and tangential velocities have been performed. The amplitudes and phase angles for the experimental and interpolated radii are shown in tabular form in Appendices G and H. Circumferential mean velocity component ratios, volumetric mean velocities and the advance angles for each survey are presented in both tabular and graphical form in these Appendices. Figures 31 and 32 present the composite results of the harmonic analyses of Experiments 8, 19, and 21. The advance angles were calculated using an advance coefficient, J_V, of 0.739.

DISCUSSION OF RESULTS

ACCURACY OF INSTRUMENTATION

The measurement system used in these velocity surveys has been described by Grant and Lin[7]. The accuracy of the pressure transducer system is approximately plus or minus three hundredths of an inch of water pressure (7.5 pascal). The accuracy of the entire velocity survey apparatus is estimated to be $\pm$ 1 percentage point on the longitudinal

velocity component ratio (VX/V), except in areas where steep velocity gradients occur. In these areas, such as behind a shaft strut, the accuracy is significantly less.

EFFECT OF HIGHER MODEL SPEED - EXPERIMENTS 2 AND 4

The data from the wake surveys at 5.22 knots (2.68 m/s), Experiment 2, and 13.5 knots (6.94 m/s), Experiment 4, are presented in Figures 21 through 26. The longitudinal and radial velocity component ratios at these two speeds show no significant difference except at the 0.781 radius. This may be due to the roll stabilizer fins not being properly aligned at the higher speed. The tangential velocity component ratios obtained from Experiment 4 have peaks which are 4 to 6 percent lower than those obtained from Experiment 2. The VXBAR shows the same trend, but with a higher value at the 0.781 radius for Experiment 4 than for Experiment 2. The VTBAR, 1-WX, and 1-WVX values are all the same.

EFFECT OF OPERATING PORT PROPELLER - EXPERIMENTS 2 AND 8

No significant differences were observed with the longitudinal and radial velocity component ratios of both these experiments. Generally, however, the longitudinal velocity component ratios are higher for Experiment 8 than Experiment 2 especially for the outer two radii - which would be affected more by the propeller operating on the port side. The tangential velocity component ratios for all four radii of Experiment 8 are lower than those from Experiment 2 from 80 to 240 degrees. Except at the extrapolated values for VXBAR, VTBAR, 1-WX, and 1-WVX near the hub, the two experiments show no significant differences.

EFFECT OF SHALLOW WATER AND STRUT BARREL - EXPERIMENTS 8, 19, AND 21

As previously stated, the experimental set-up of Experiments 19 and 21 differed from that of Experiment 8 by the extension of the starboard strut barrel and the addition of the port rudder. The results from Experiments 19 and 21 indicate that there are no appreciable differences in the wake due to the water depth of the towing tank at the same trim setting. However, the setting of the shallow water trim does affect the results of the wake survey conducted in deep water. The three velocity

components from Experiments 19 and 21 show differences when compared to those of Experiment 8. The longitudinal velocity component ratios are lower for Experiments 19 and 21 than those for Experiment 8, except for the 0.781 radius ratio. The tangential velocity component ratios are generally lower for Experiments 19 and 21 than those of Experiment 8, except for the outermost radius ratio of 0.963. These differences in the data are just beyond experimental accuracy. Mixed conclusions are drawn from results with the radial velocity component ratios. For radius ratios of 0.456 and 0.781, the values are marginally lower; while for radius ratios of 0.633 and 0.963, the ratios are significantly higher for the shallow water trim experiments. The VTBAR shows no marked difference due to trim. However, the VXBAR, 1-WX, and 1-WVX show trends of lower values for shallow water trim with the shallow water results being the lowest.

DIFFERENCES IN VELOCITY COMPONENT RATIOS BETWEEN EXPERIMENTS

Table 3 presents some of the results from harmonic analysis of the data from Experiments 2, 7, 3, 9, 4, 8, 19, and 21 for the 0.781 radius. The analysis of experimental data for these wake surveys shows a trend toward a higher circumferential mean longitudinal velocity component ratio for the model trimmed in shallow water with the port propeller turning. The repeatability of this quantity is good between the R/V ATHENA model experiments. There is little difference in mean longitudinal velocity due to the port propeller turning for Experiments 2 and 8. There are no differences in this quantity for Experiments 19 and 21 due to water depth at the same trim setting. For Experiments 2 and 4, the difference in mean longitudinal velocity is about 2%. This difference is explained by the increased Froude number and change in wave pattern while restraining the trim to a set value.

The trend in the mean longitudinal data is clearly an increase with increasing speed-length ratio. Table 4 presents the data for mean velocity components and advance angles for four speeds at a radius ratio of 0.781. The trend of increasing mean longitudinal velocity with ship speed is clearly shown in Table 4.

The data from Experiment 2 without the port propeller operating were compared to that of Experiment 8 with the propeller operating. No

significant differences were observed in the longitudinal and radial velocity component ratios. However, the tangential velocity component ratio shows about a 2% change due to the propeller operating. The agreement is considered to be within experimental accuracy with the present instrumentation.

COMPARISON OF MODEL- AND FULL-SCALE DATA

Experiments 2 and 8 were performed to provide model-scale data for correlation with full-scale wake survey data. The velocity component ratios computed from ship and model data are presented in Figures 15 through 18. Table I-1 presents the velocity component ratios for the full-scale wake survey experiment.

The data from model experiments agree with the full-scale measurements reasonably well for the outer radii. The large differences in the longitudinal velocity component in the innermost radius are most probably due to difficulties measuring model velocities in the vicinity of the large propeller hub, which is at a significant angle to the flow due to the shaft angle. The differences between full-scale and model-scale measurements of the tangential velocity components are also larger for the innermost radius measured.

The results of the model experiments in deep water at the deep water trim setting, Experiment 8, and in shallow water at the shallow water trim setting, Experiment 21, are presented in Figures I-1 through I-4 along with the full-scale data. A study of the velocity component ratios presented in these figures shows that the degree of scatter of the full-scale data is higher than that of the model data in deep and shallow water. In particular, the full-scale data for the longitudinal velocity component ratios at the innermost radius of 0.456 show the largest scatter, and the greatest deviation from the model-scale wake. In part, this scatter is also due to the fact that the longitudinal velocity component ratios presented are an average of the longitudinal component calculated from the radial and tangential velocity component ratios. This tends to magnify any scatter in the radial and tangential velocity component ratios. Another possible contributing factor to the scatter

of the innermost radius is the close proximity of the pitot tube to the strut bossings.

The longitudinal velocity component ratios at the innermost radius are about 10% lower for the ship than for the model, while the peaks of the tangential velocity component ratios are about 10% higher for the ship than for the model. At the two outer radii of 0.781 and 0.963, the longitudinal velocity component ratios for the ship are 2 to 4 percent lower than those for the model. The peaks of the tangential velocity component ratios at the outer radii are 8 to 10 percent higher for the ship than for the model. The radial velocity component ratios at the two outermost radii are about 8 to 10 percent lower for the ship than for the model.

The periodic propeller blade loads on high speed transom stern vessels such as the R/V ATHENA arise primarily from the first harmonic of the tangential velocity component ratio. Calculations of periodic blade loads by the method of Kerwin and Lee[8] indicate that the periodic blade loads in the wake as measured full-scale would be approximately 27 percent higher than in the wake as measured model-scale.

CONCLUSIONS

1. No significant effect on the mean wake distribution due to the operating port propeller was observed.

2. The longitudinal and radial velocity component ratios between wake surveys at 5.22 knots (2.68 m/s) and 13.5 knots (6.94 m/s) show no difference except at the 0.781 radius due to the change in model speed above 5.22 knots (2.68 m/s) when the trim was held the same. The tangential velocity component ratios obtained at 13.5 knots (6.94 m/s) have peaks which are 4 to 6 percent lower than those obtained at 5.22 knots (2.68 m/s).

3. The mean longitudinal velocity component increases with increasing speed when the trim is fixed. The velocity defect from the shafts is less with increasing speed. Only slight increases occur in the radial velocity components with a change in speed.

4. No appreciable difference in the wake is shown due to the water depth of the towing tank when the model is fixed at the same trim setting.

5. The setting of the shallow water trim does seem to affect the results of the wake survey conducted in deep water. However, this difference is not significant enough to explain the differences between the previous model and full-scale experiments.

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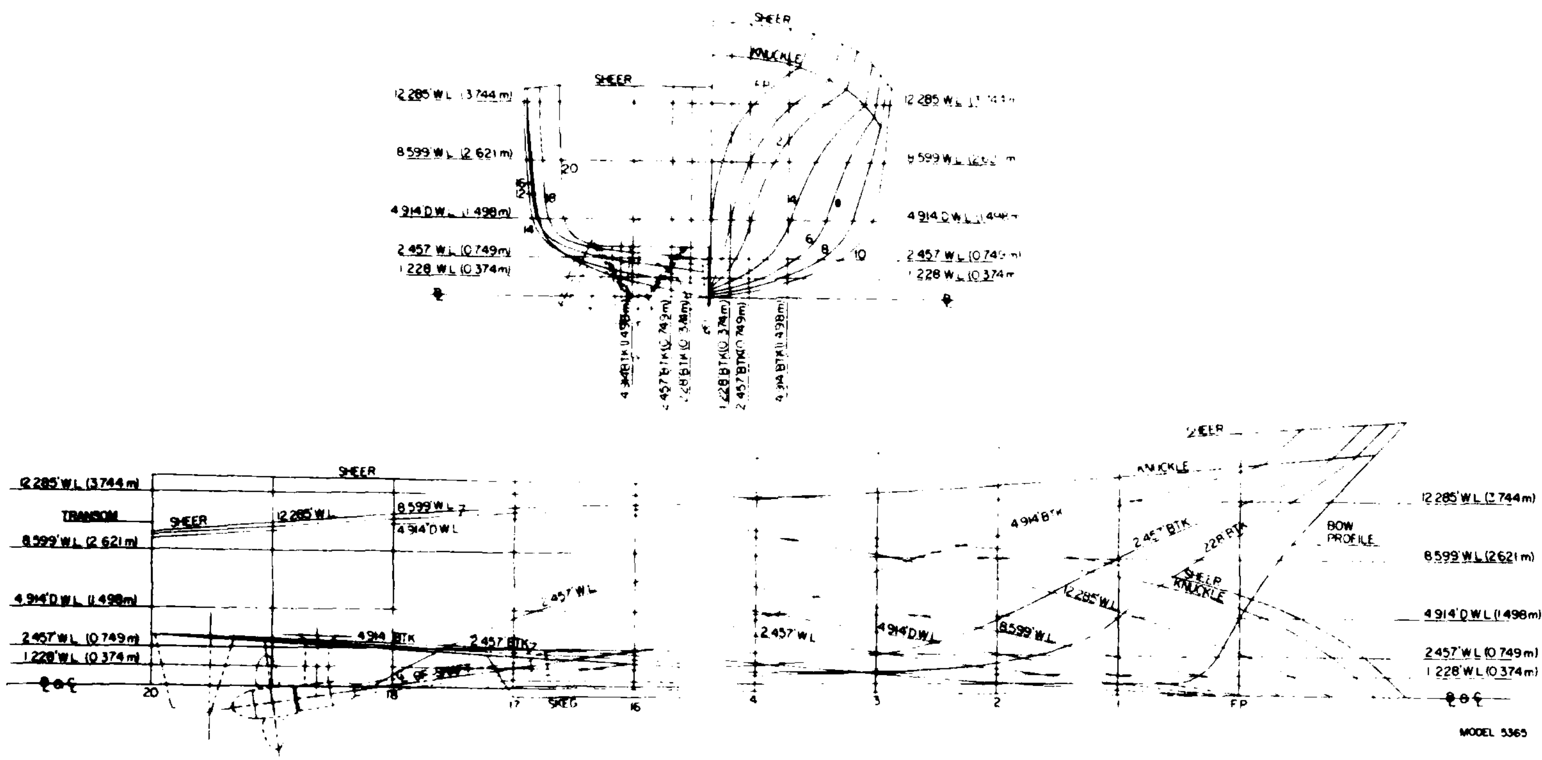


Figure 1 - Profile Lines and Body Plan for the R/V ATHENA Represented by Model 5365

	PROP NO	LINEAR RATIO	DIA MODEL	DIA SHIP	PITCH MODEL AT 70 PCT	PITCH SHIP AT 70 PCT	PITCH RATIO AT 70 PCT	NUMBER OF BLADES	EXP AREA	E.A./D.A.	M.W.R.	PROJ AREA	P.A./D.A.	B.T.F.	RAKE ANGLE AT TIP	ROTATION		SECTION LENGTH MODEL AT 70 PCT.
INCHES MM	4710	8.250	8.727 221.67	72.000 1828.80	9.697 246.30	80.000 2032.00	1.111	4	46.358 29908.6	0.775	0.443	40.100 25871.1	0.670	0.048	0.000	R.H.		4.698 119.33
INCHES MM	4711	8.250	8.727 221.67	72.000 1828.90	9.697 246.30	80.000 2032.00	1.111	4	46.358 29908.6	0.775	0.443	40.100 25871.1	0.670	0.048	0.000	L.H.		4.698 119.33

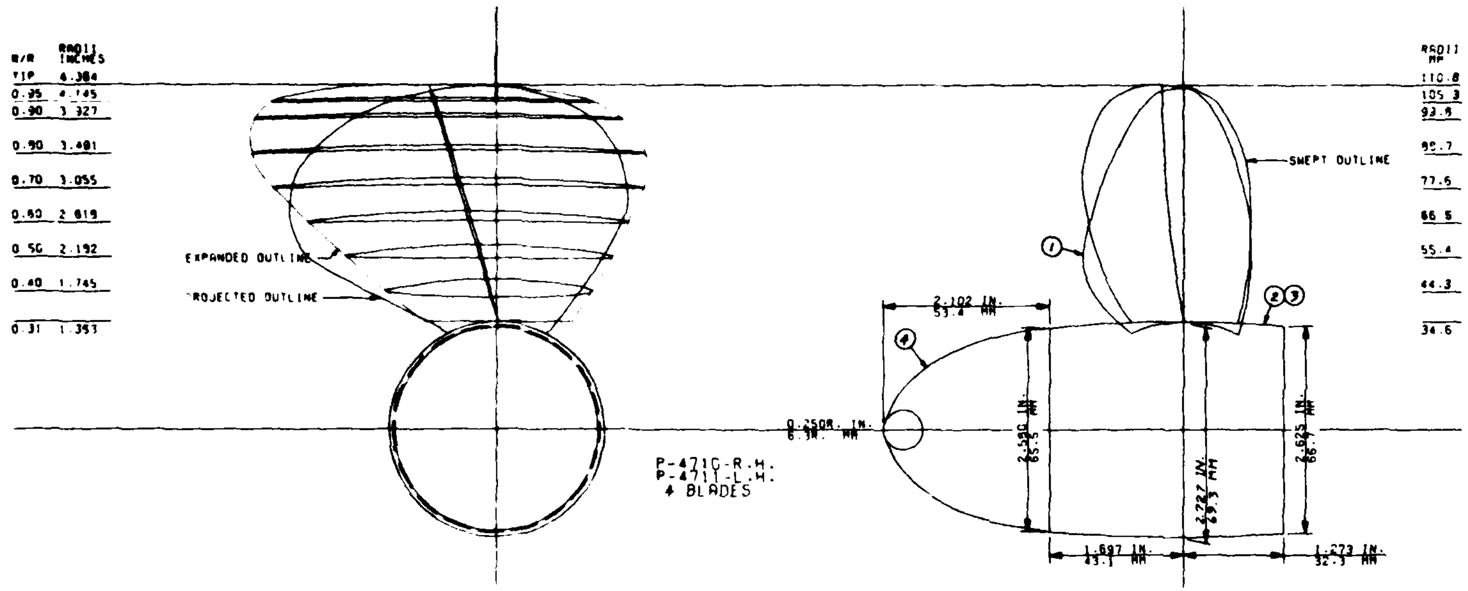


Figure 2 - Controllable Pitch Propeller Geometry

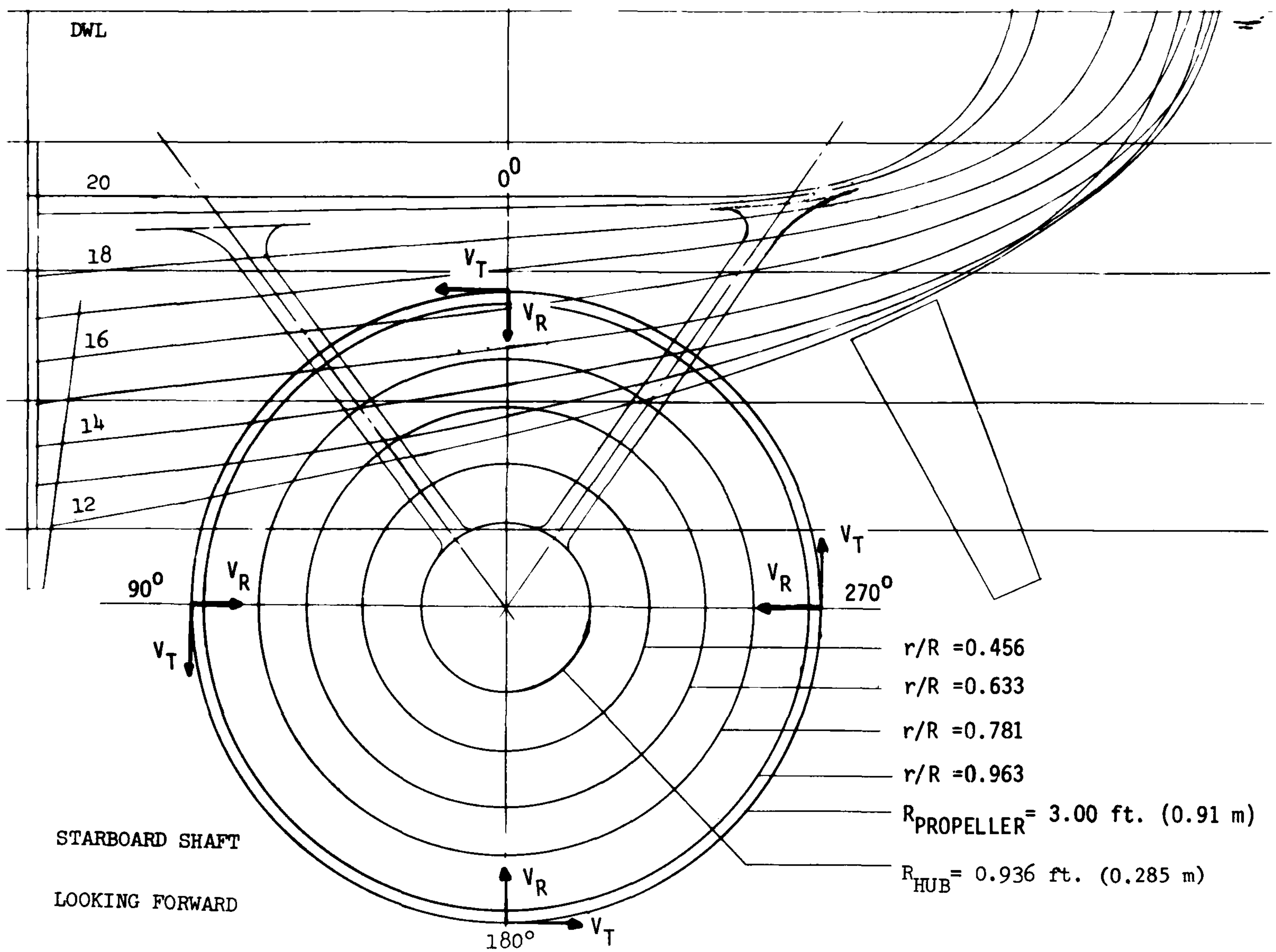


Figure 3 - Afterbody of Hull Showing Radii of Wake Survey Measurements

PSD-0604-5-78-3

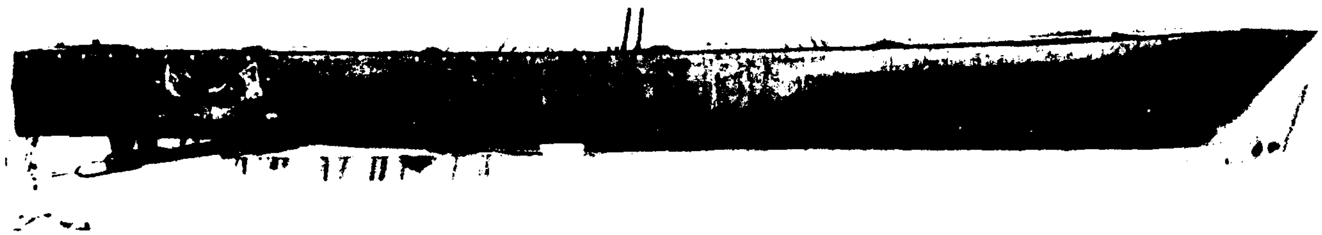


Figure 4a - Fitting Room Photograph of Model 5365 Representing the R/V ATHENA for Experiments 2,3, 4, 5, 7, and 9 without Propeller

PSD-0604-5-78-2

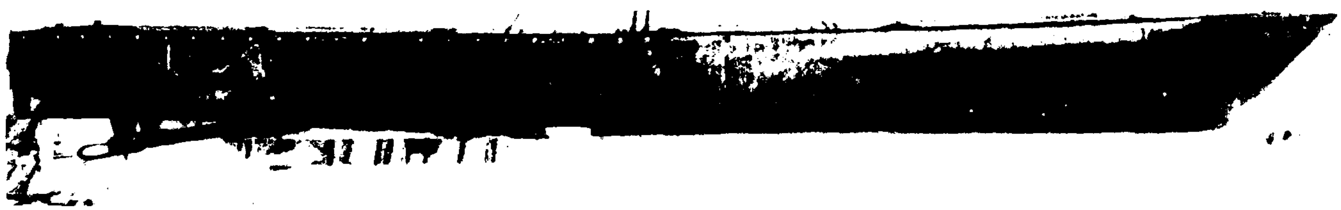


Figure 4b - Fitting Room Photograph of Model 5365 Representing the R/V ATHENA for Experiments 6 and 8 with Propeller

Figure 4 - Fitting Room Photographs of DTNSRDC Model 5365 Representing the R/V ATHENA

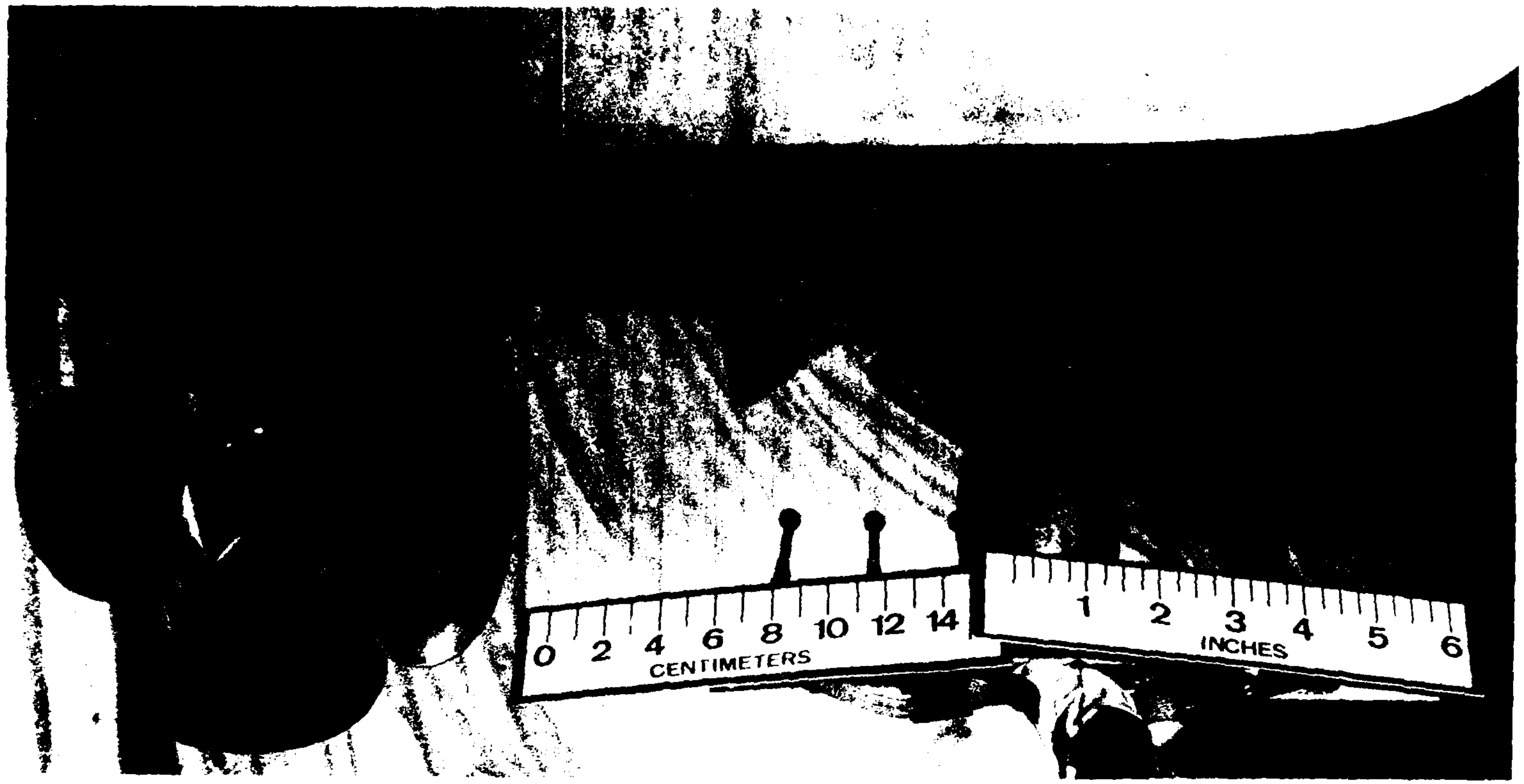


Figure 5 - After End View of DTNSRDC Model 5365 Fitted with a Rake of Five-Hole Pitot Tubes on the Starboard Shaft

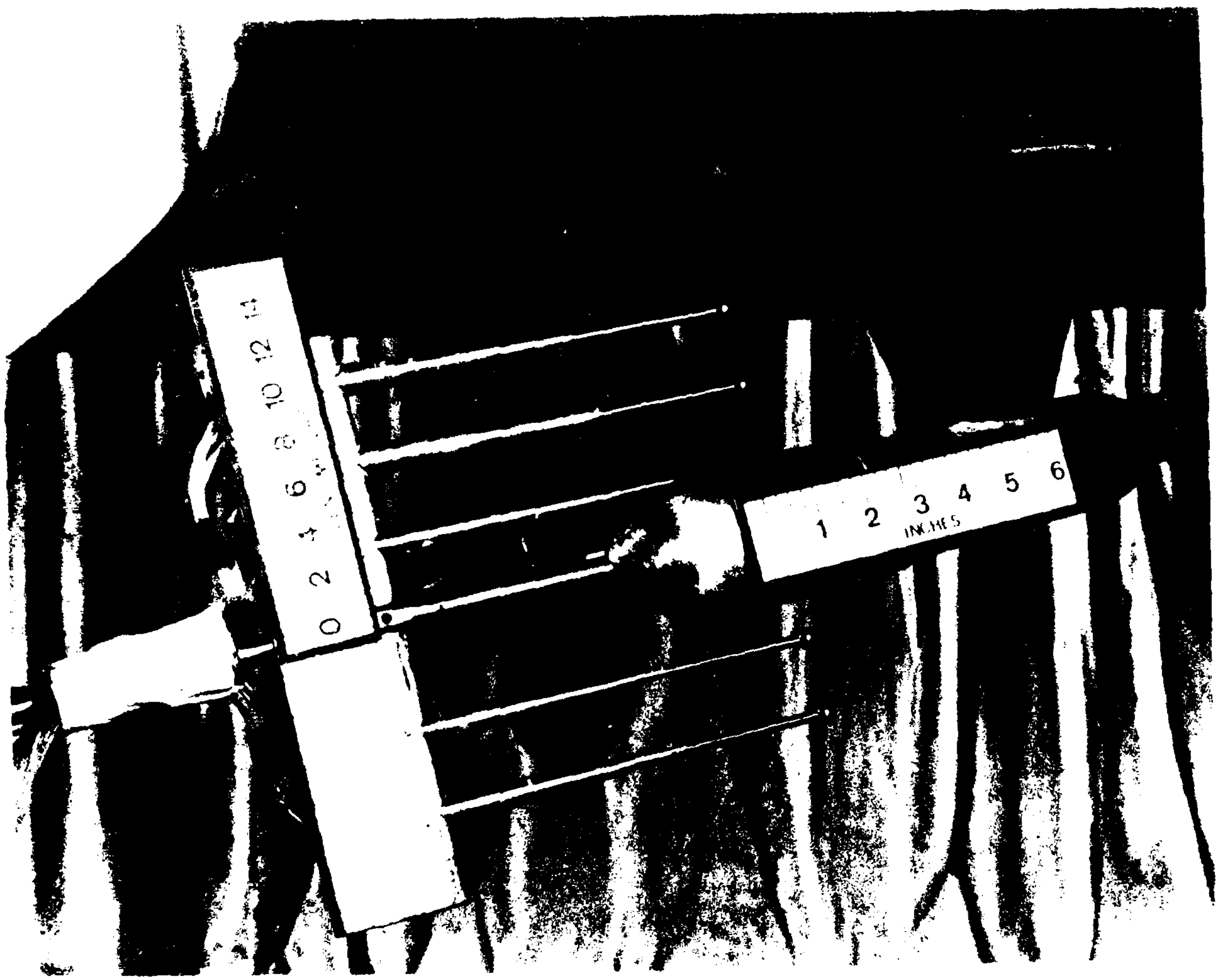


Figure 6 - Afterbody Quarter View of DTNSRDC Model 5365 Fitted with a Rake of Five-Hole Pitot Tubes on the Starboard Shaft

PSD-0604-5-78-11

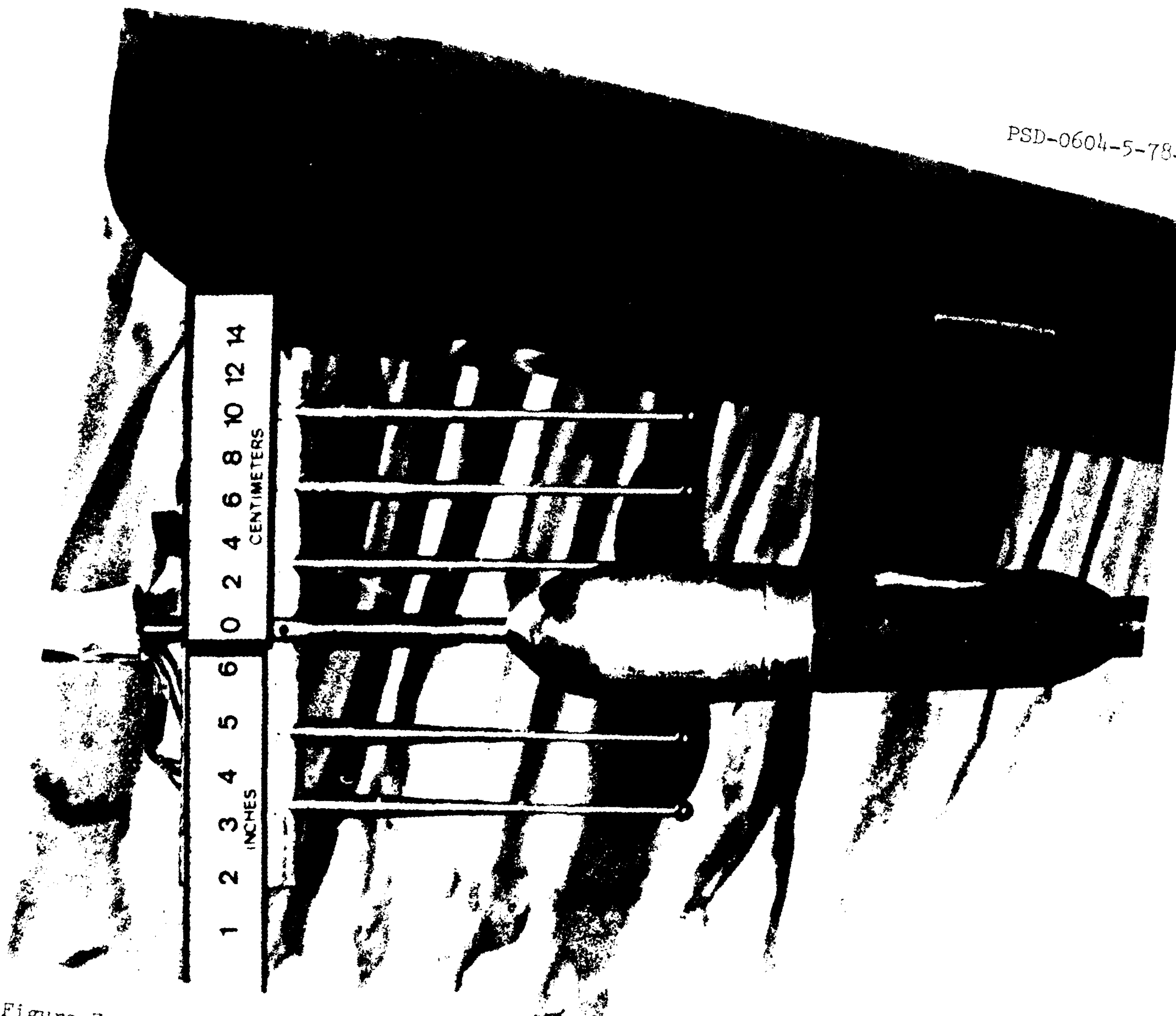


Figure 7 - Afterbody Profile View of DTNSRDC Model [illegible] Fitted with a Rake of Five-Hole Pitot Tubes on the Starboard Shaft

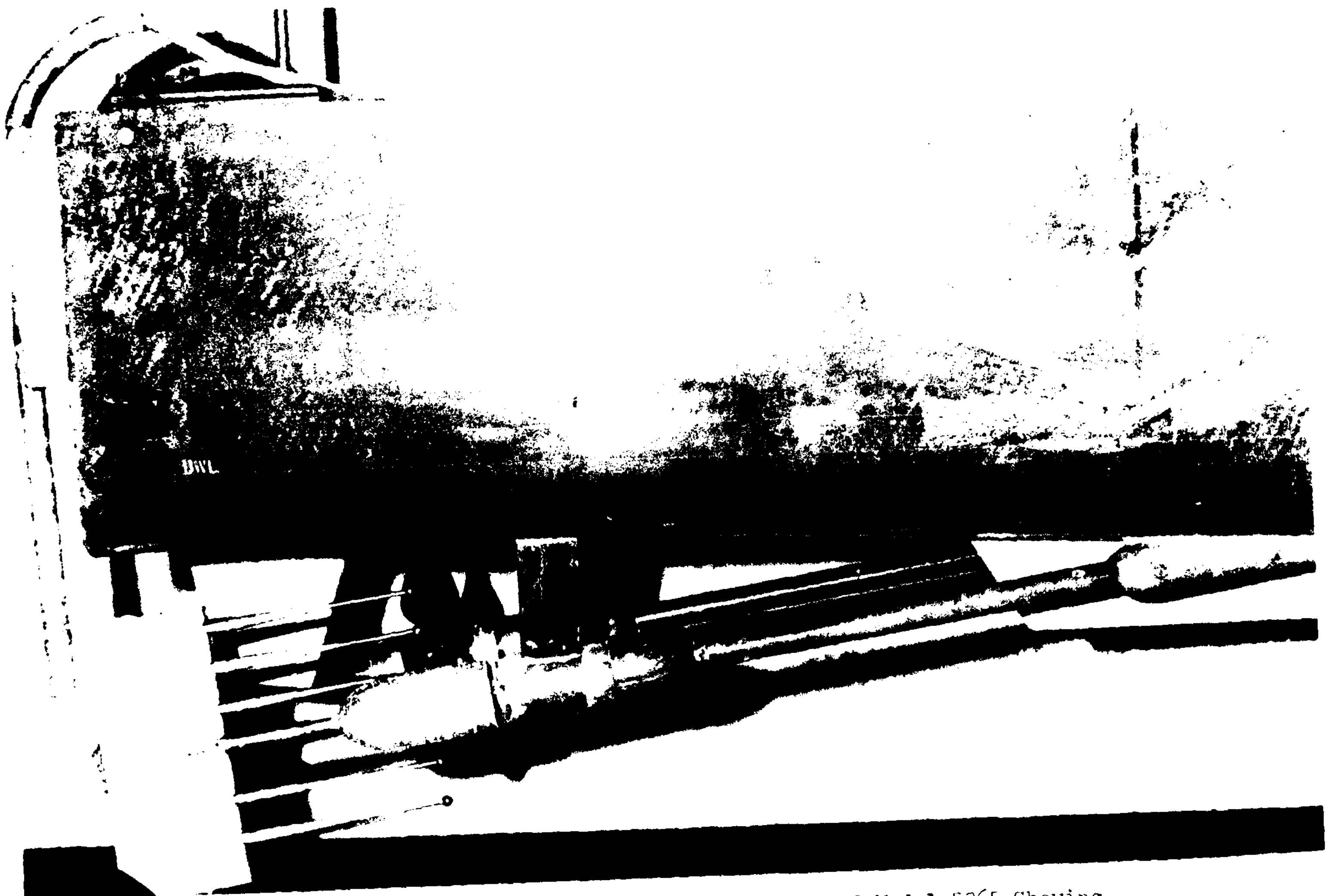


Figure 8 - Starboard Afterbody Profile View of DTNSRDC Model 5365 Showing Strut Barrel Extension

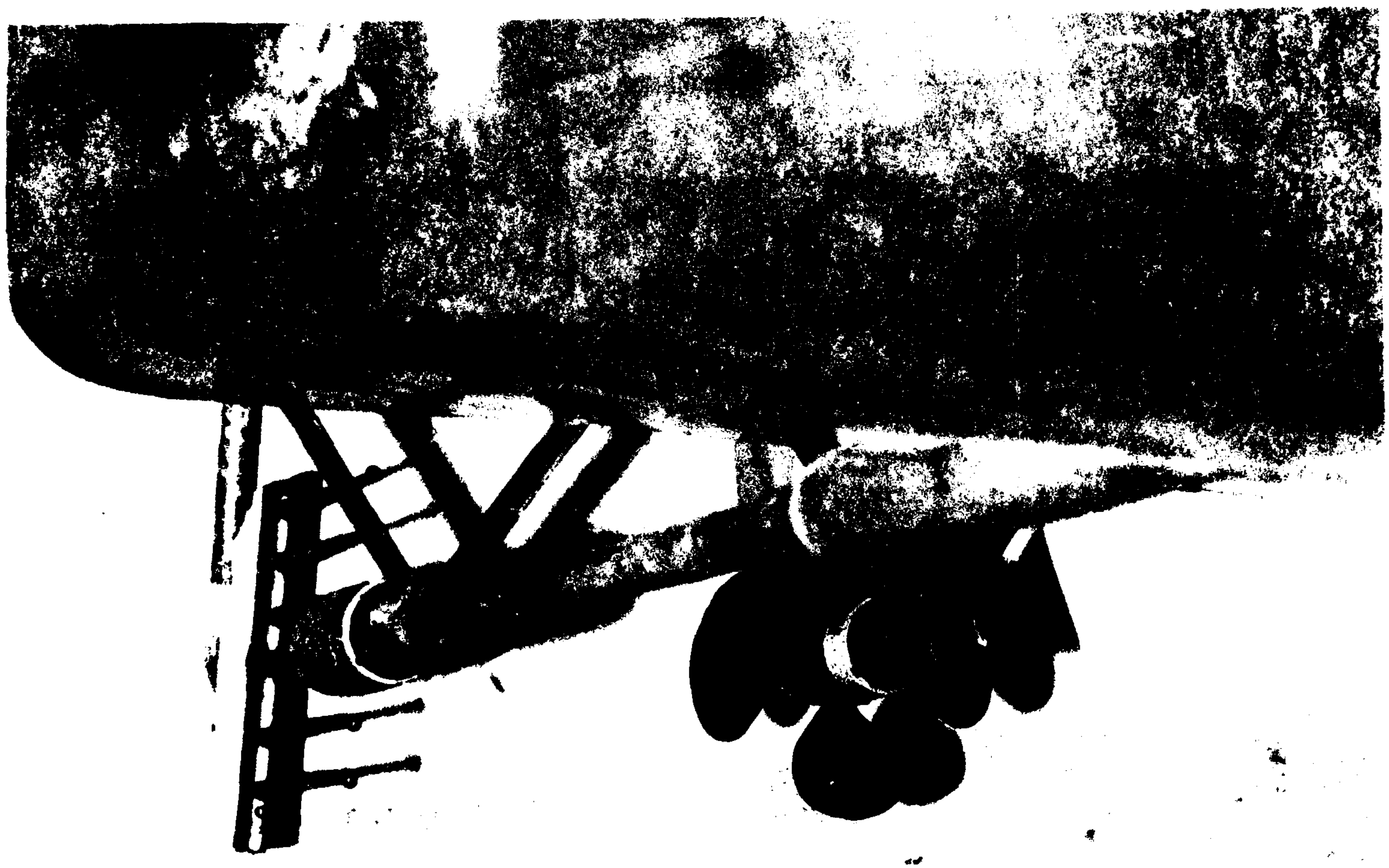


Figure 9 - Starboard Quarter View of DTNSRDC Model 5365 Showing Strut Barrel Extension

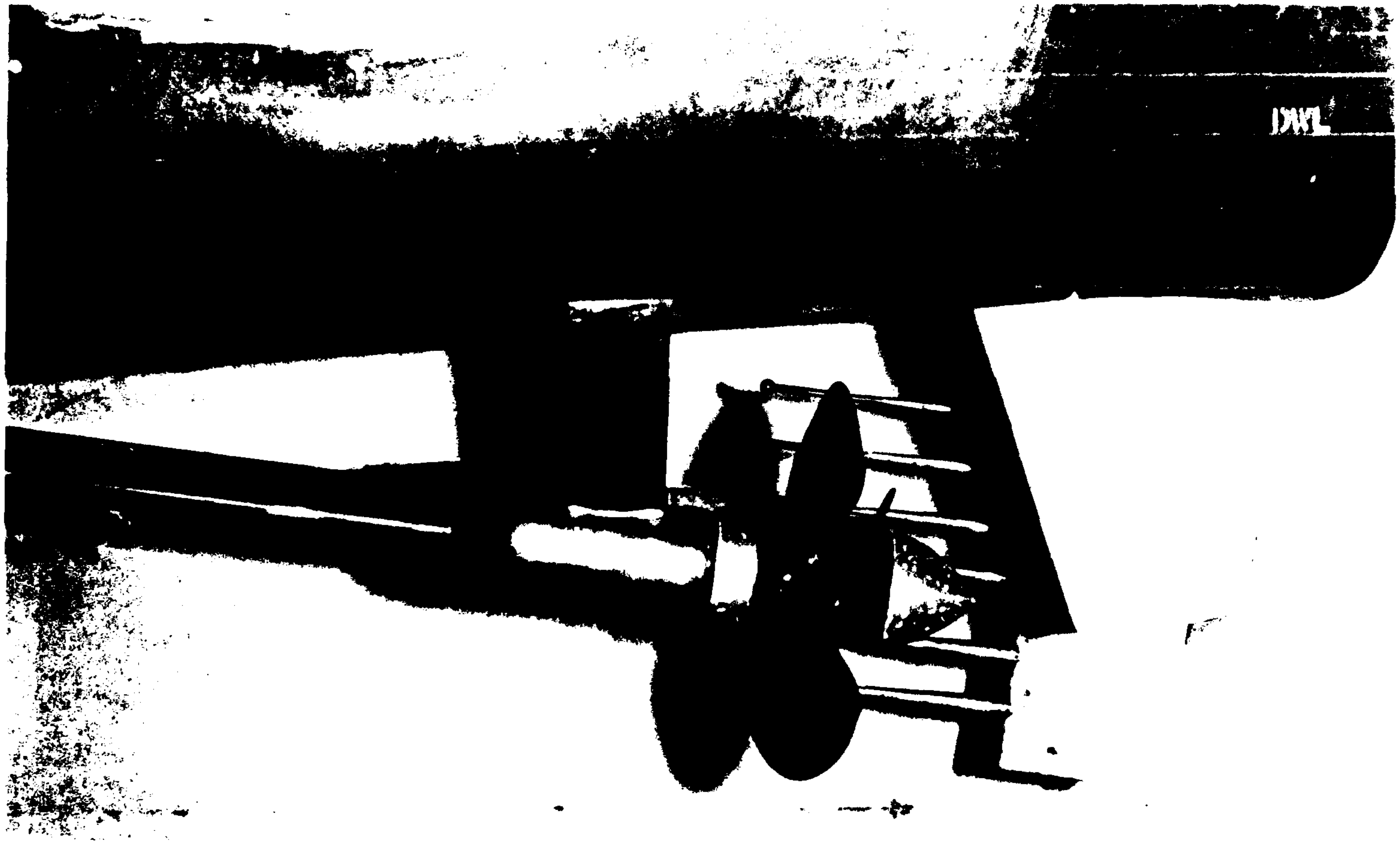


Figure 10 - Port Afterbody Profile View of DTNSRDC Model 5365 Showing Propeller and Rudder

Figure 11 - Bow Wave Profile of DTNSRDC Model 5365 in Shallow Water at the Shallow Water Trim Setting at a Speed Corresponding to 15 Knots, Full-Scale

Figure 12 - Stern Wave Profile of DTNSRDC Model 5365 in Shallow Water at the Shallow Water Trim Setting at a Speed Corresponding to 15 Knots, Full-Scale

Figure 13 - Bow Wave Profile of DTNSRDC Model 5365 in Deep Water at the Shallow Water Trim Setting at a Speed Corresponding to 15 Knots, Full-Scale

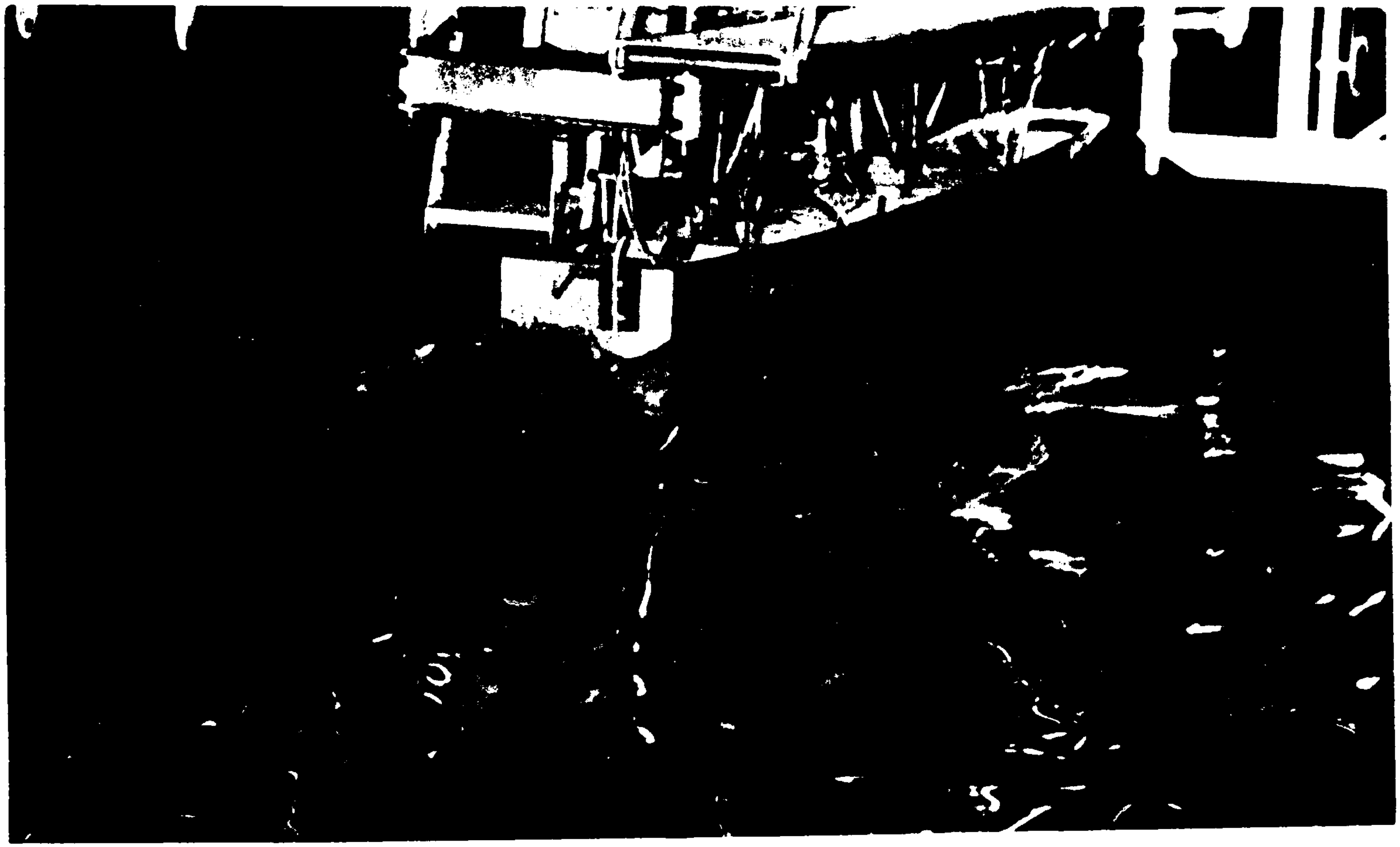
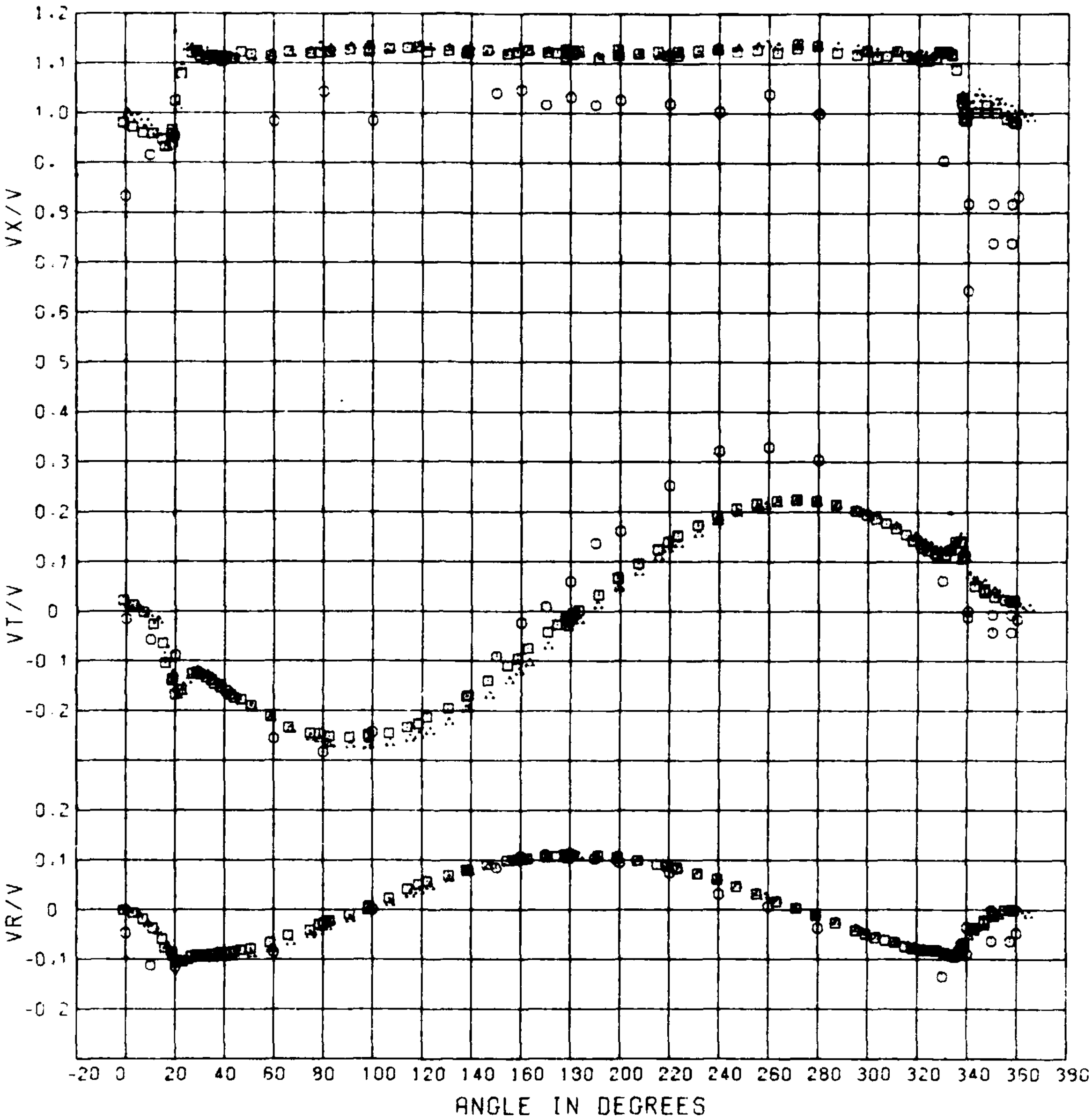


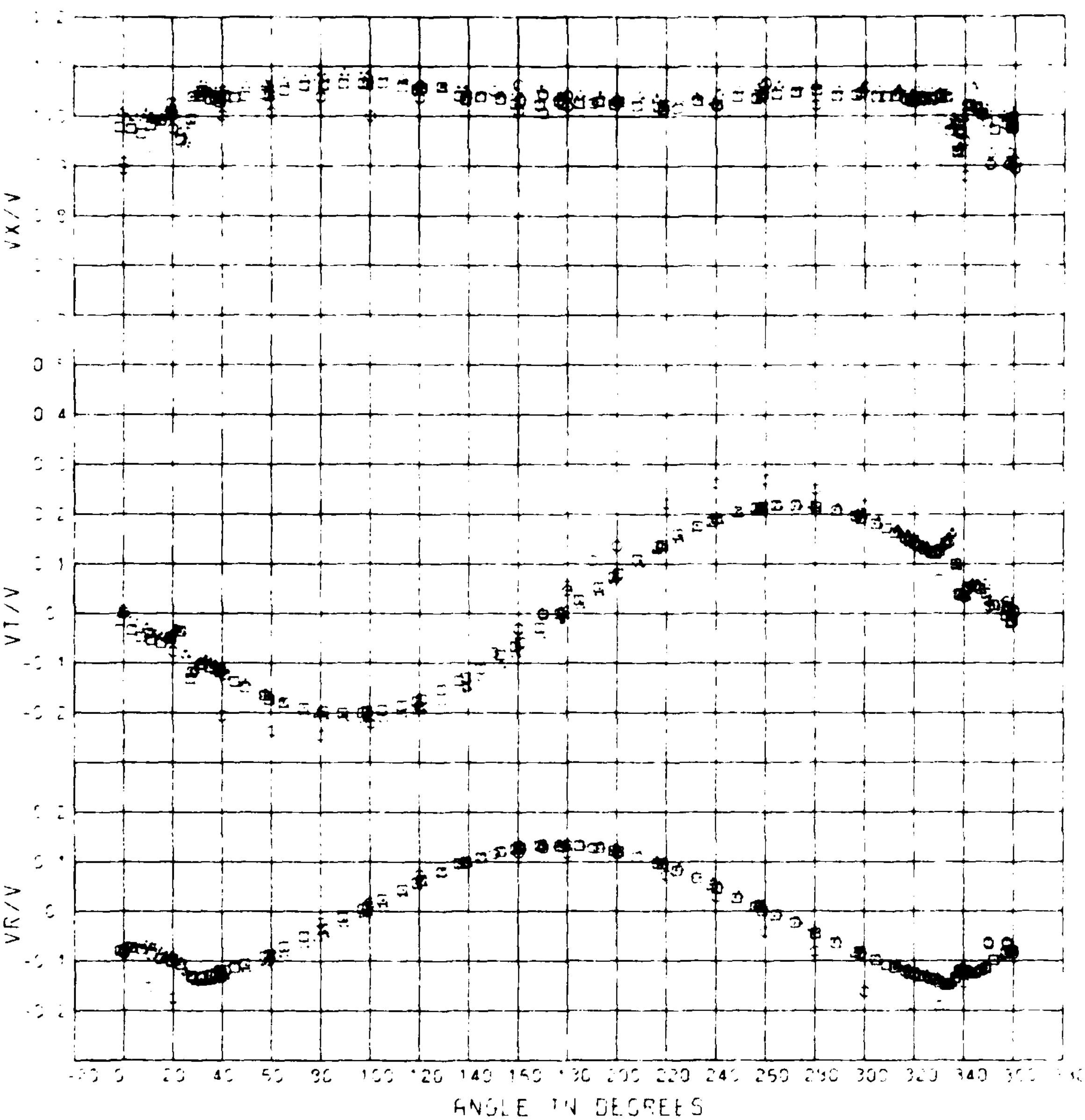
Figure 14 - Stern Wave Profile of DTNSRDC Model 5365 in Deep Water at the Shallow Water Trim Setting at a Speed Corresponding to 15 knots, Full-Scale



□ MODEL 5365, EXPERIMENT 2 WITHOUT PROPELLER
▲ MODEL 5365, EXPERIMENT 8 WITH PROPELLER
⊙ FULL-SCALE R/V ATHENA

0.456 R D.

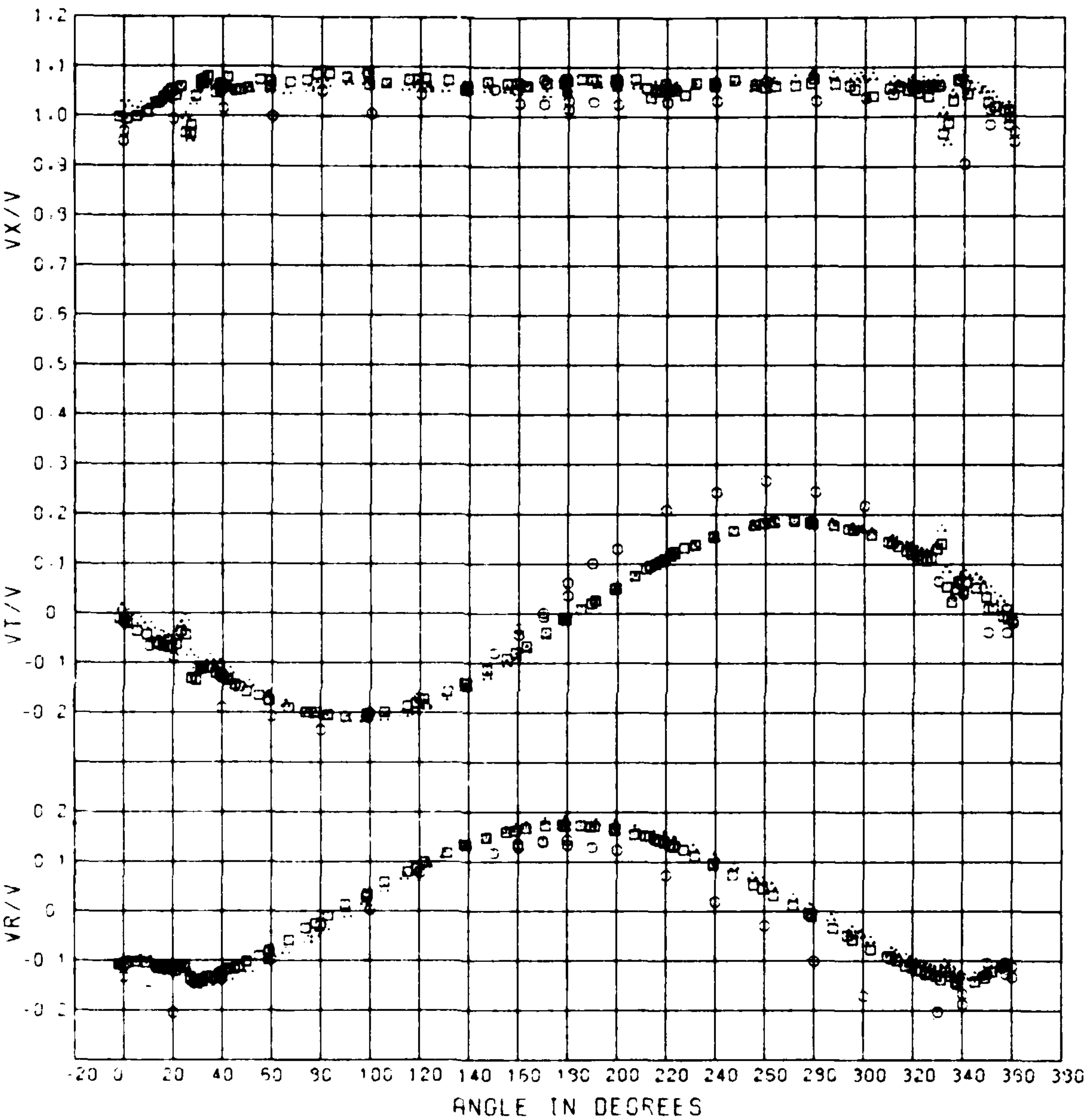
Figure 15 - Composite Plot of Velocity Component Ratios from R/V ATHENA and Model Experiments 2 and 8 for the 0.456 Radius



□ MODEL 5365, EXPERIMENT 2 WITHOUT PROPELLER
△ MODEL 5365, EXPERIMENT 8 WITH PROPELLER
◇ FULL-SCALE R/V ATHENA

0.633 RAD

Figure 16 - Composite Plot of Velocity Component Ratios from R/V ATHENA and Model Experiments 2 and 8 for the 0.633 Radius



□ MODEL 5365, EXPERIMENT 2 WITHOUT PROPELLER
+ MODEL 5365, EXPERIMENT 8 WITH PROPELLER
○ FULL-SCALE R/V ATHENA

0.781 RAD.

Figure 17 - Composite Plot of Velocity Component Ratios from R/V ATHENA and Model Experiments 2 and 8 for the 0.781 Radius

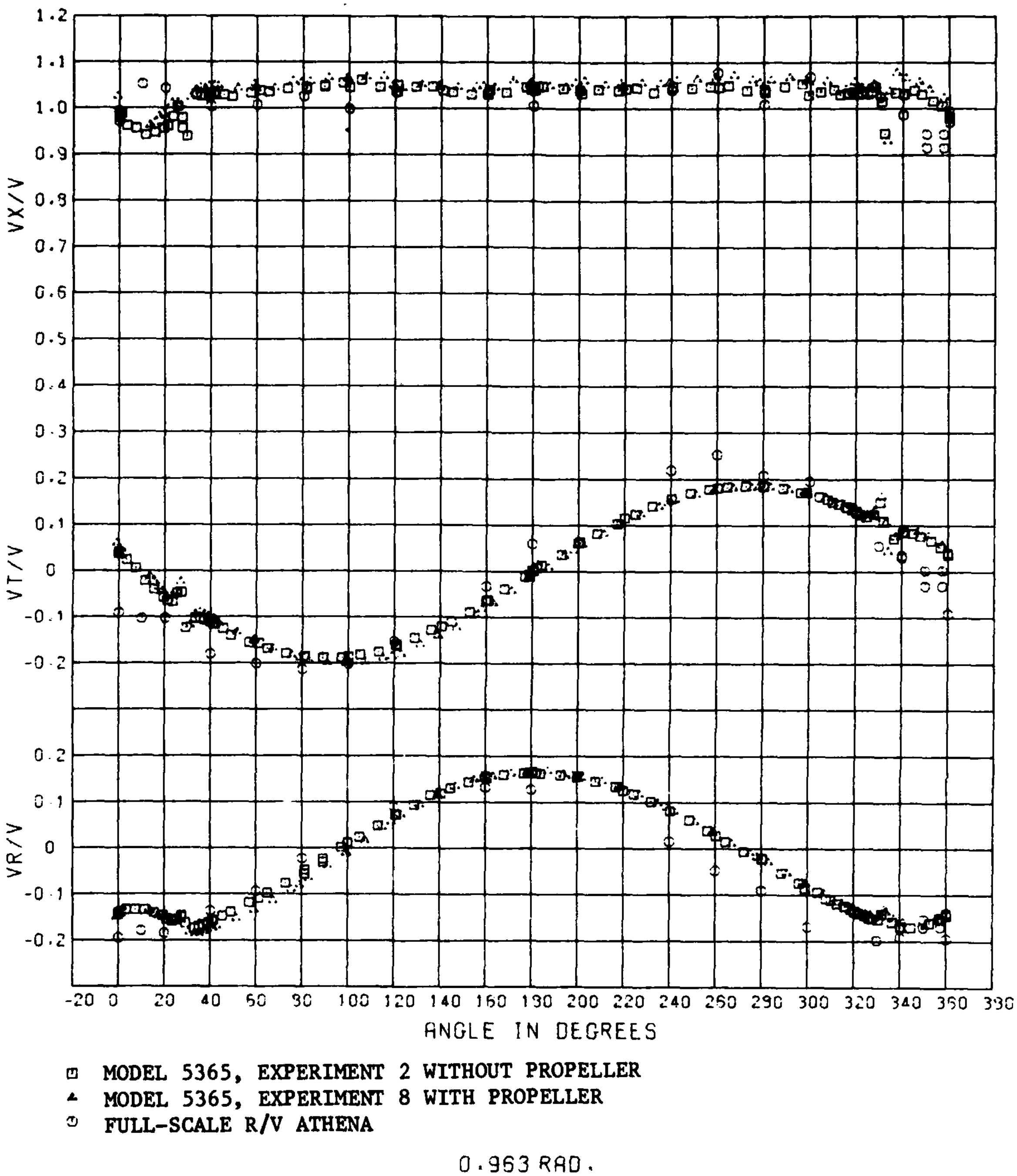


Figure 18 - Composite Plot of Velocity Component Ratios from R/V ATHENA and Model Experiments 2 and 8 for the 0.963 Radius

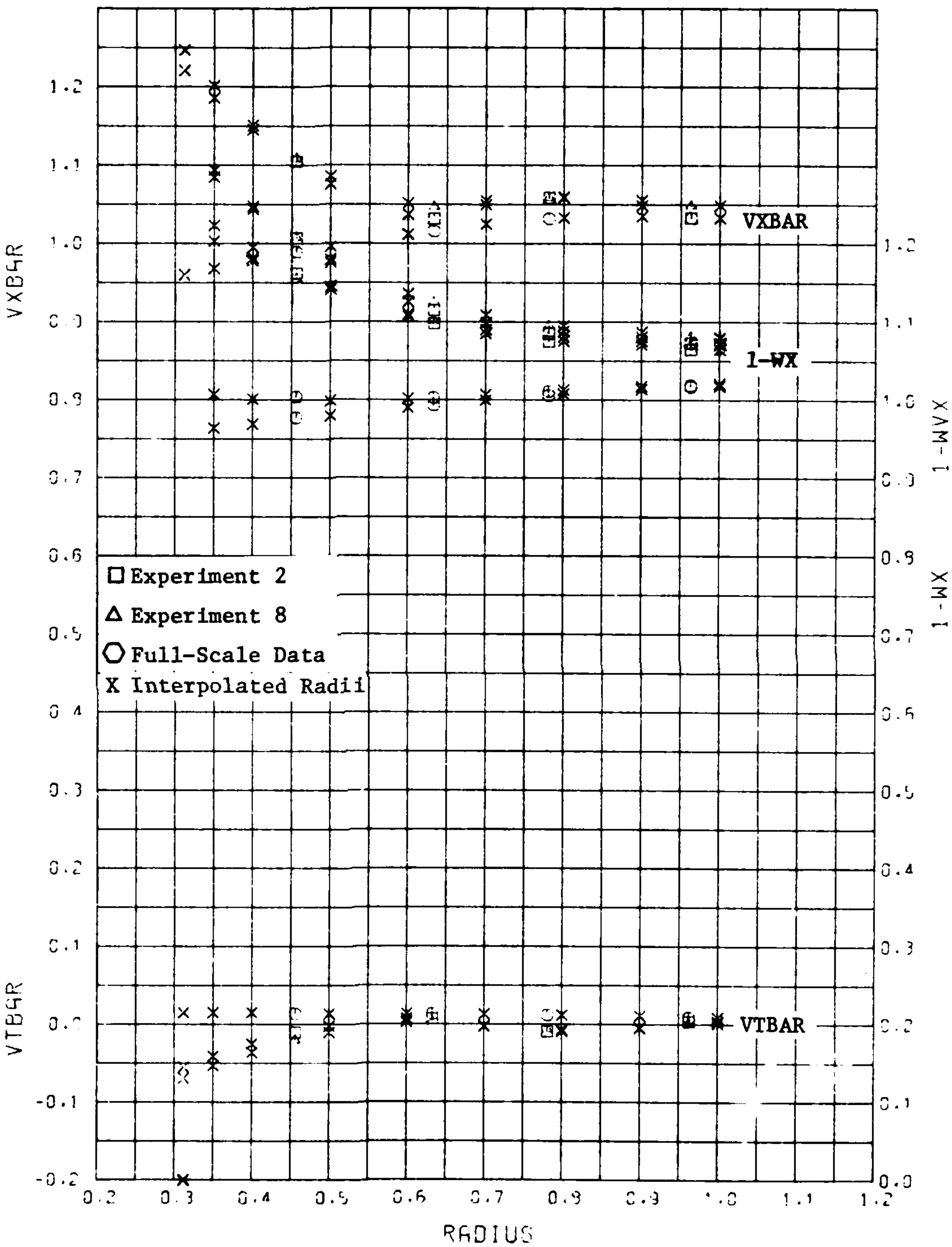


Figure 19 - Composite Plot of Mean Longitudinal, Tangential, and Volumetric Mean Wake from R/V ATHENA and Experiments 2 and 8

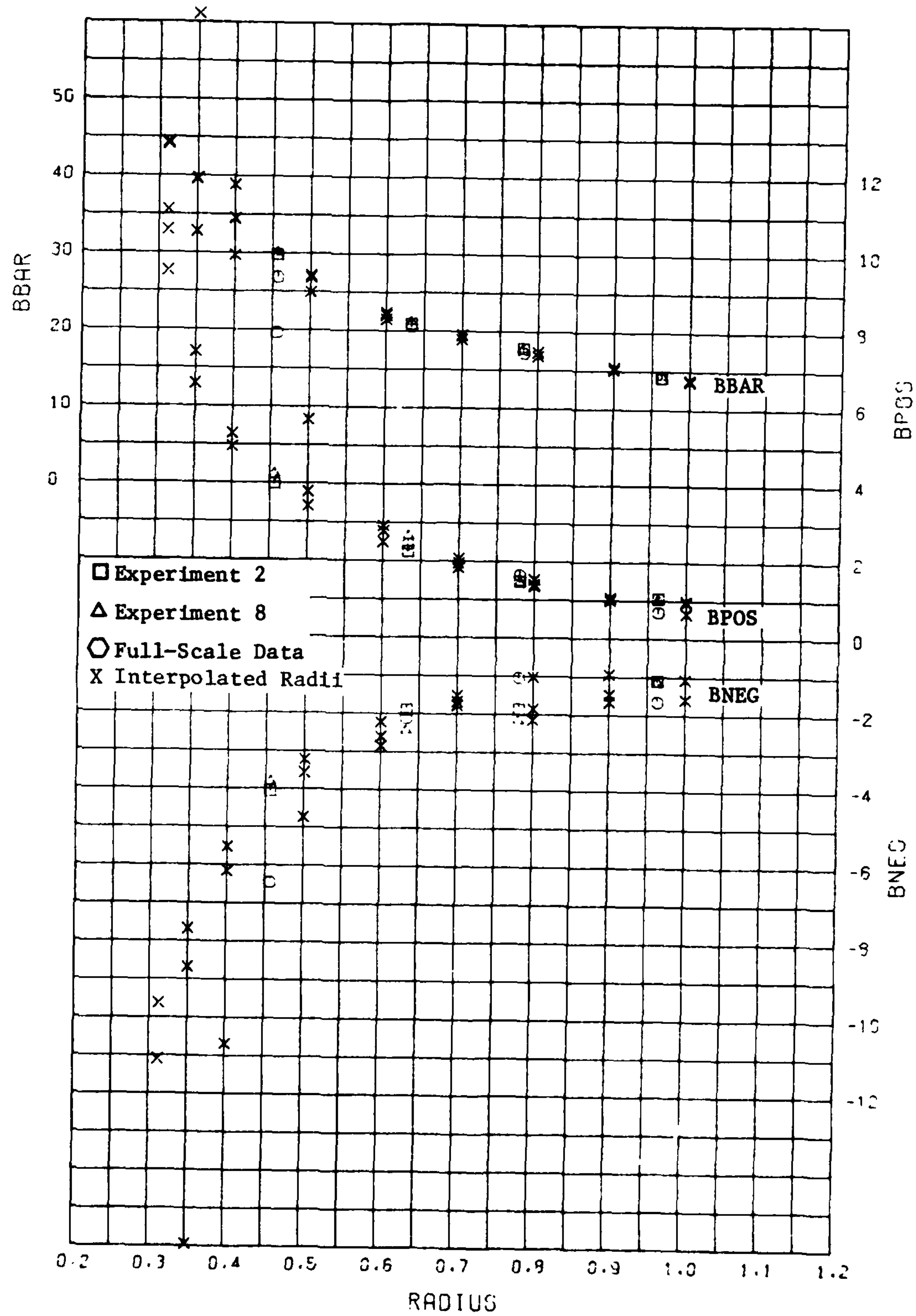


Figure 20 - Composite Plot of Mean Advance Angle (Beta) and Maximum Variations of Advance Angle from R/V ATHENA and Experiments 2 and 8

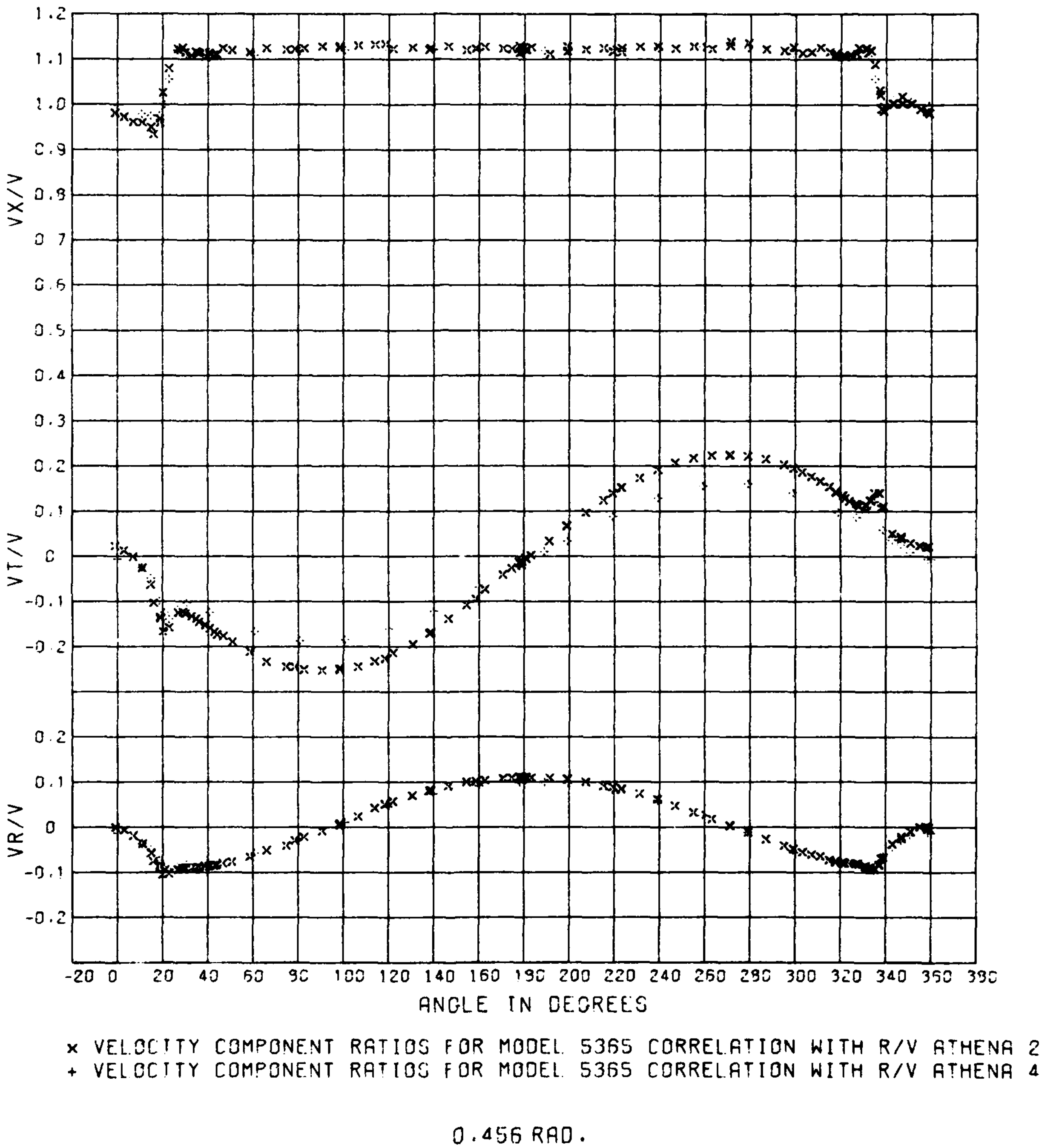


Figure 21 - Velocity Component Ratios of Experiments 2 and 4 for Two Model Speeds for the 0.456 Radius

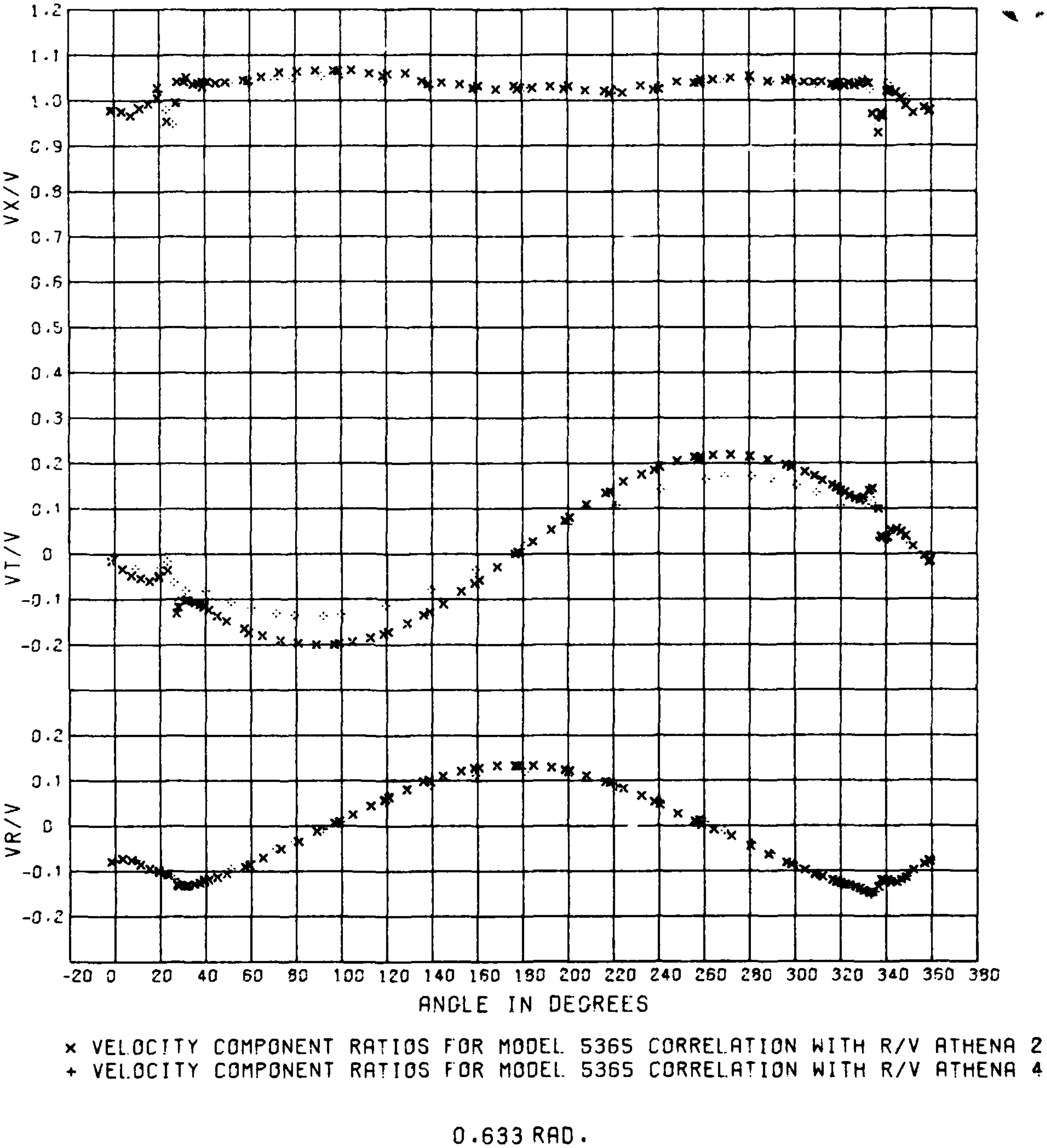


Figure 22 - Velocity Component Ratios of Experiments 2 and 4 for Two Model Speeds for the 0.633 Radius

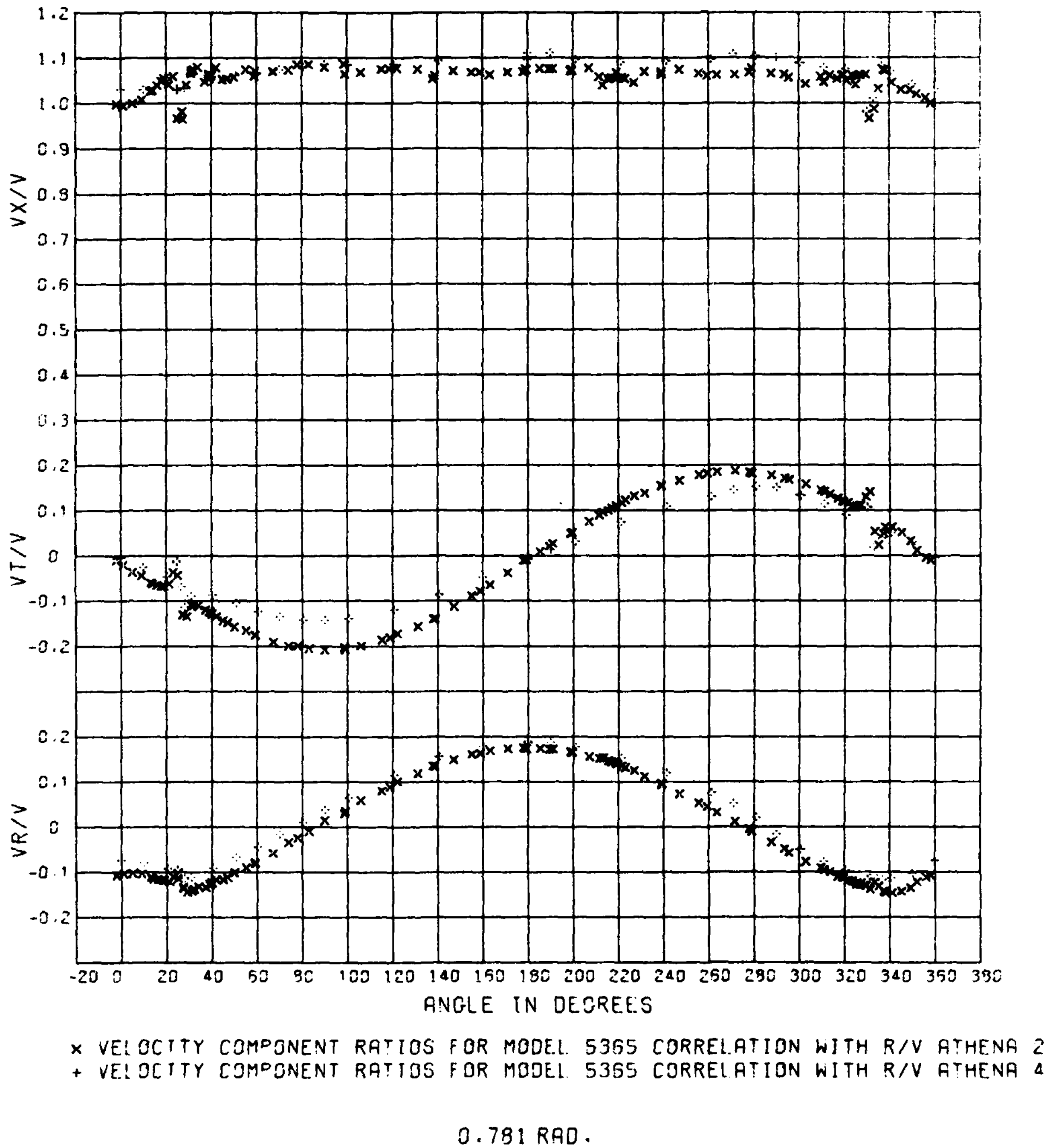


Figure 23 - Velocity Component Ratios of Experiments 2 and 4
for Two Model Speeds for the 0.781 Radius

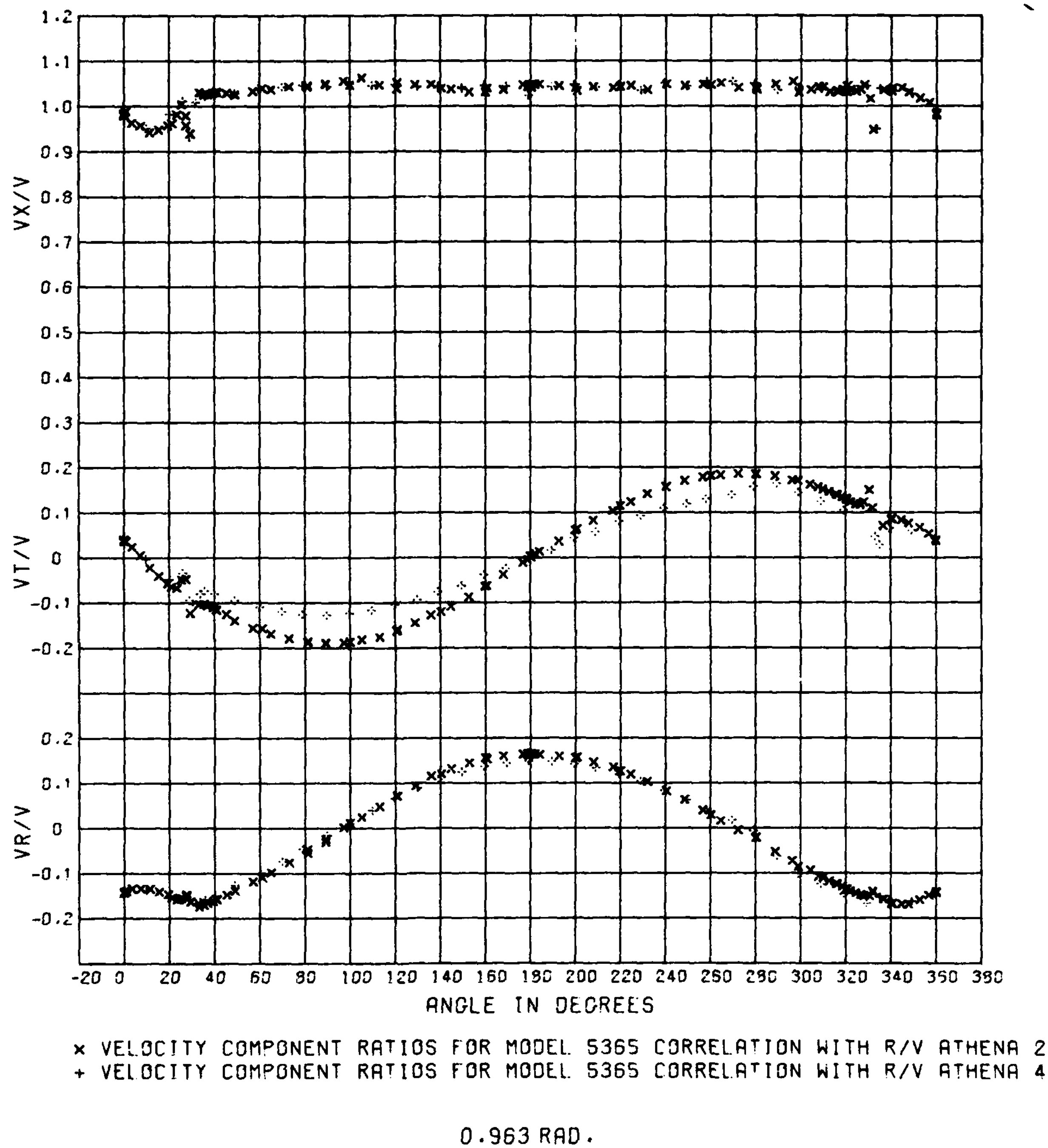


Figure 24 - Velocity Component Ratios of Experiments 2 and 4 for Two Model Speeds for the 0.963 Radius

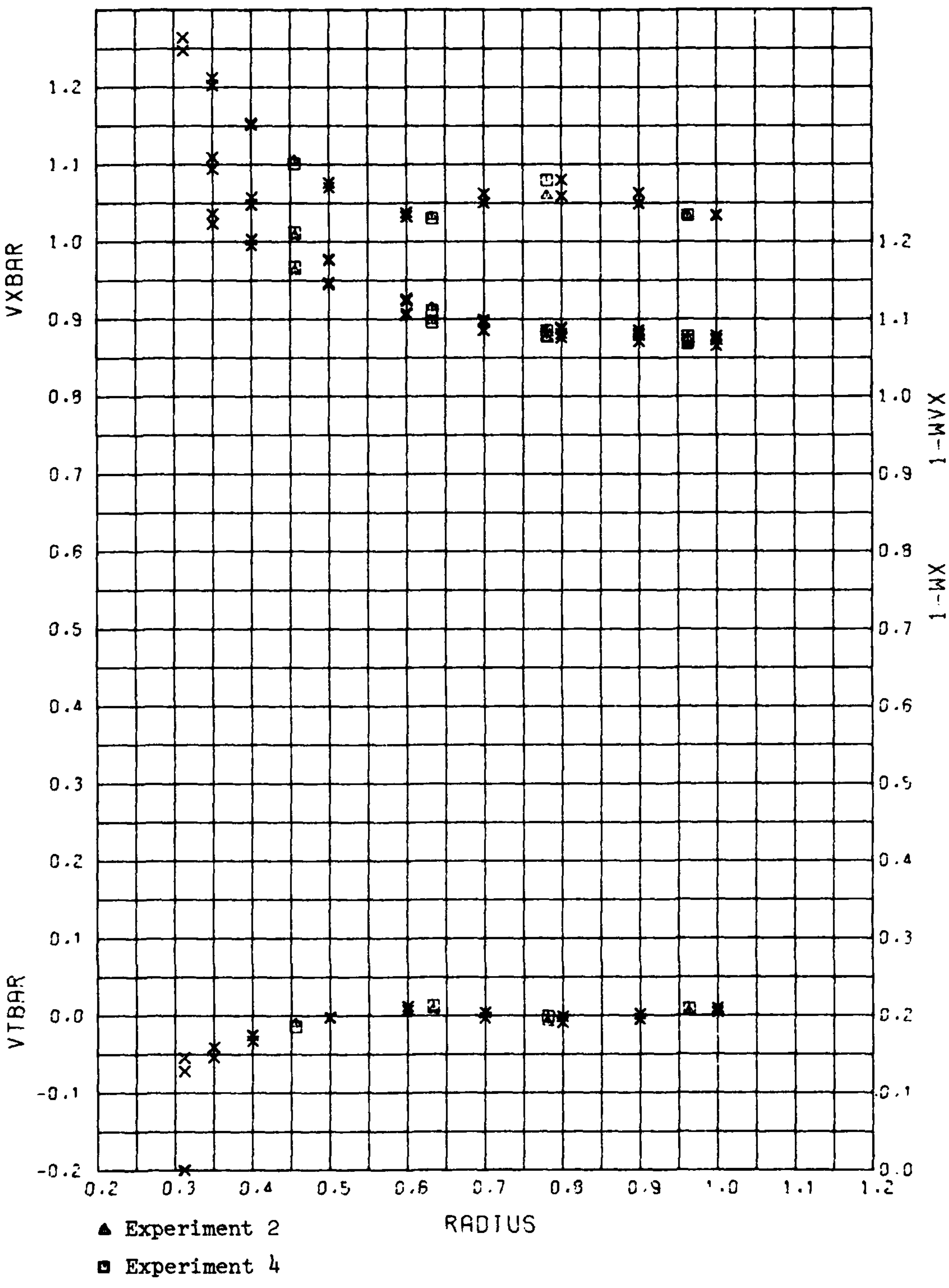


Figure 25 - Composite Plot of Mean Longitudinal, Tangential, and Volumetric Mean Wake of Experiments 2 and 4

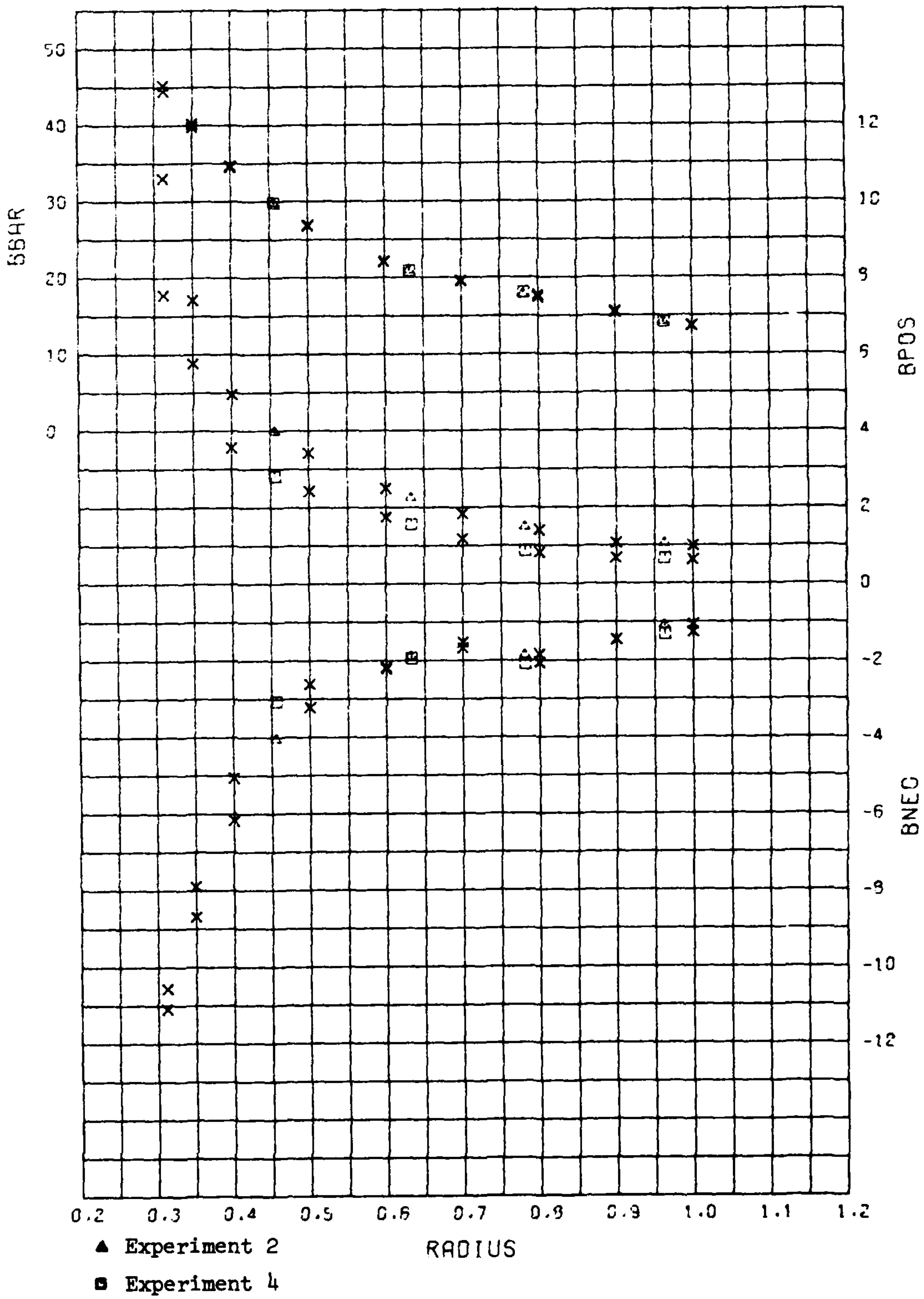


Figure 26 - Composite Plot of Mean Advance Angle (Beta) and Maximum Variations of Advance Angle of Experiments 2 and 4

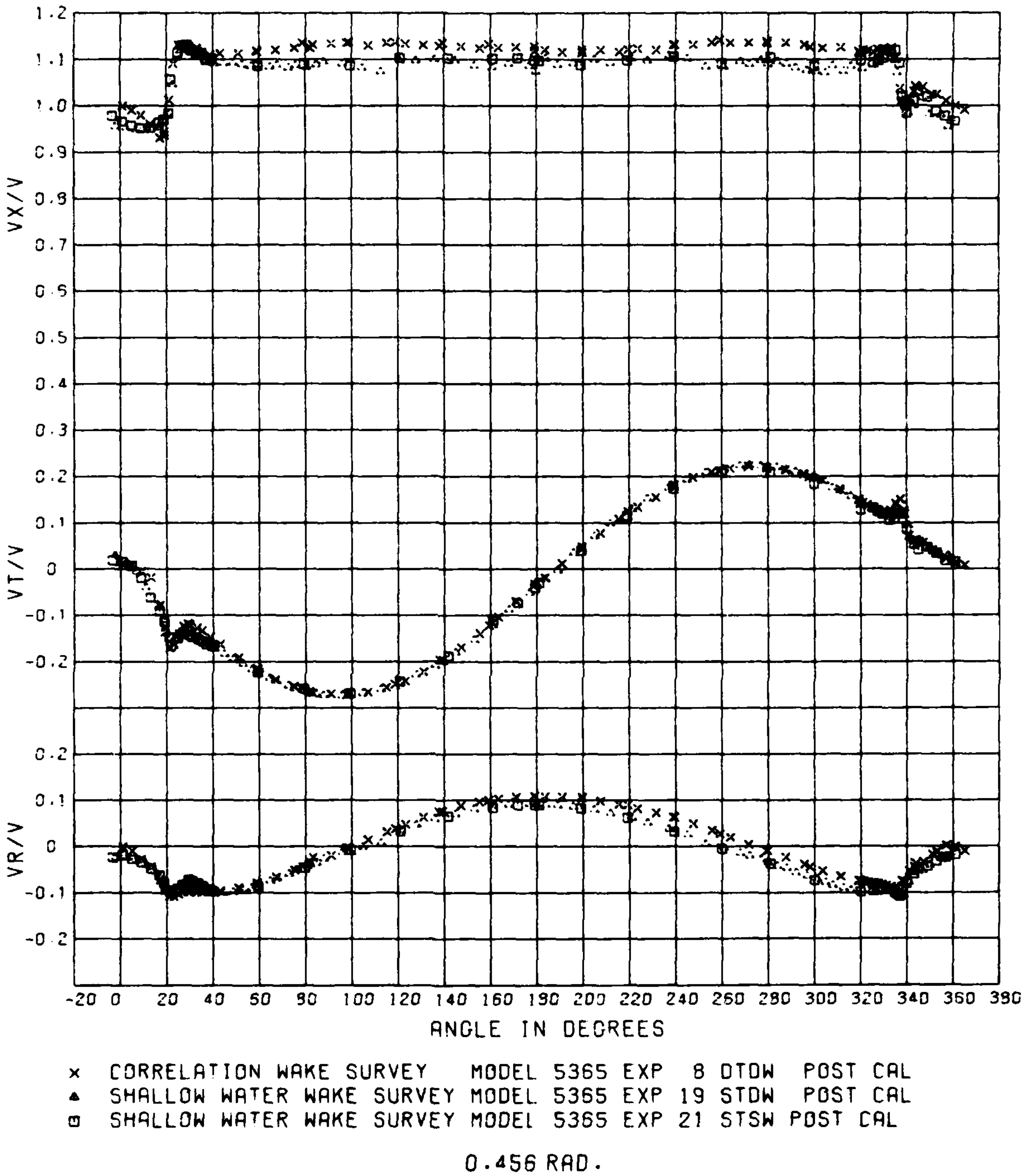


Figure 27 - Composite Plot of Velocity Component Ratios for Experiments 8, 19, and 21 for the 0.456 Radius

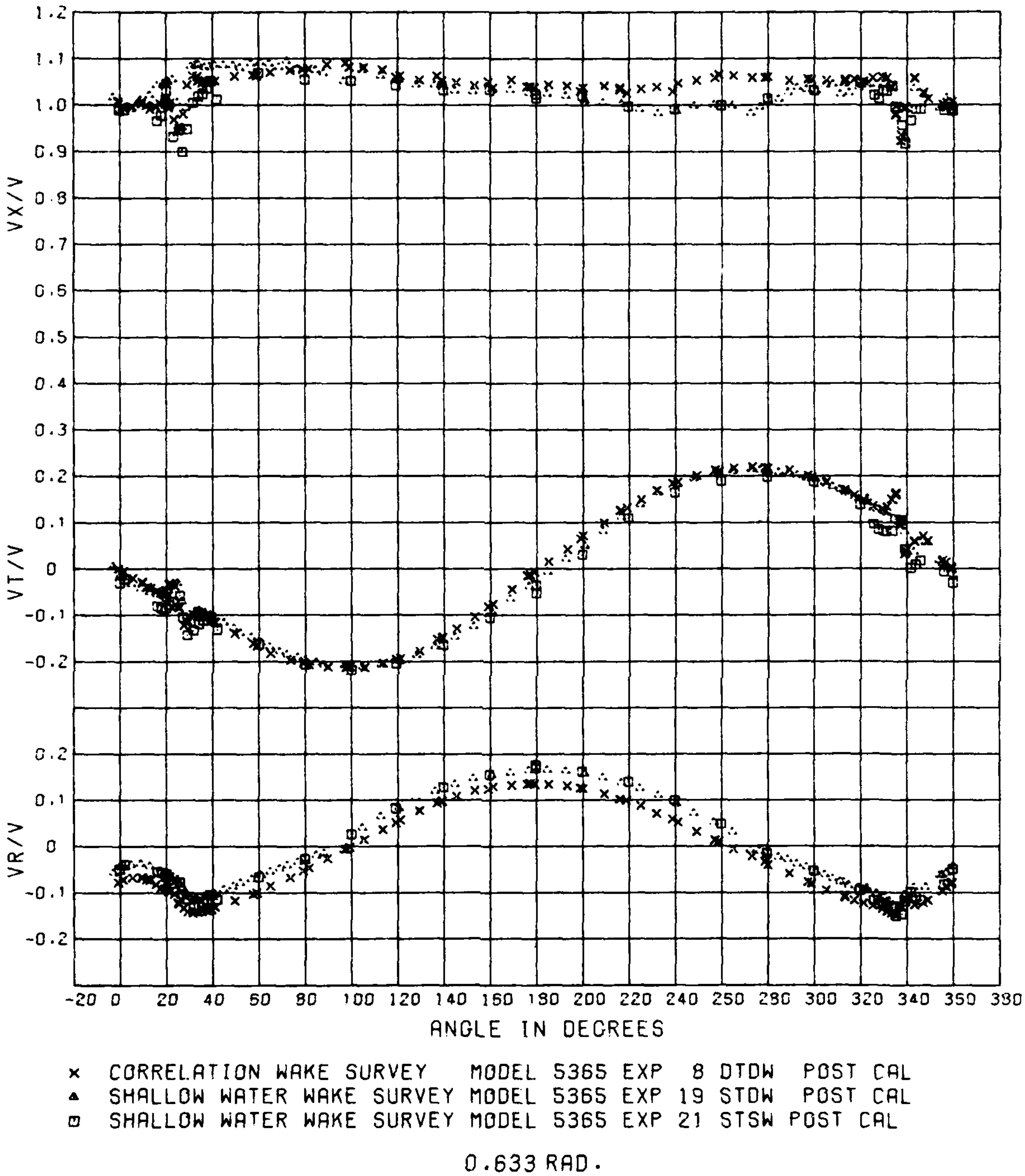


Figure 28 - Composite Plot of Velocity Component Ratios for Experiments 8, 19, and 21 for the 0.633 Radius

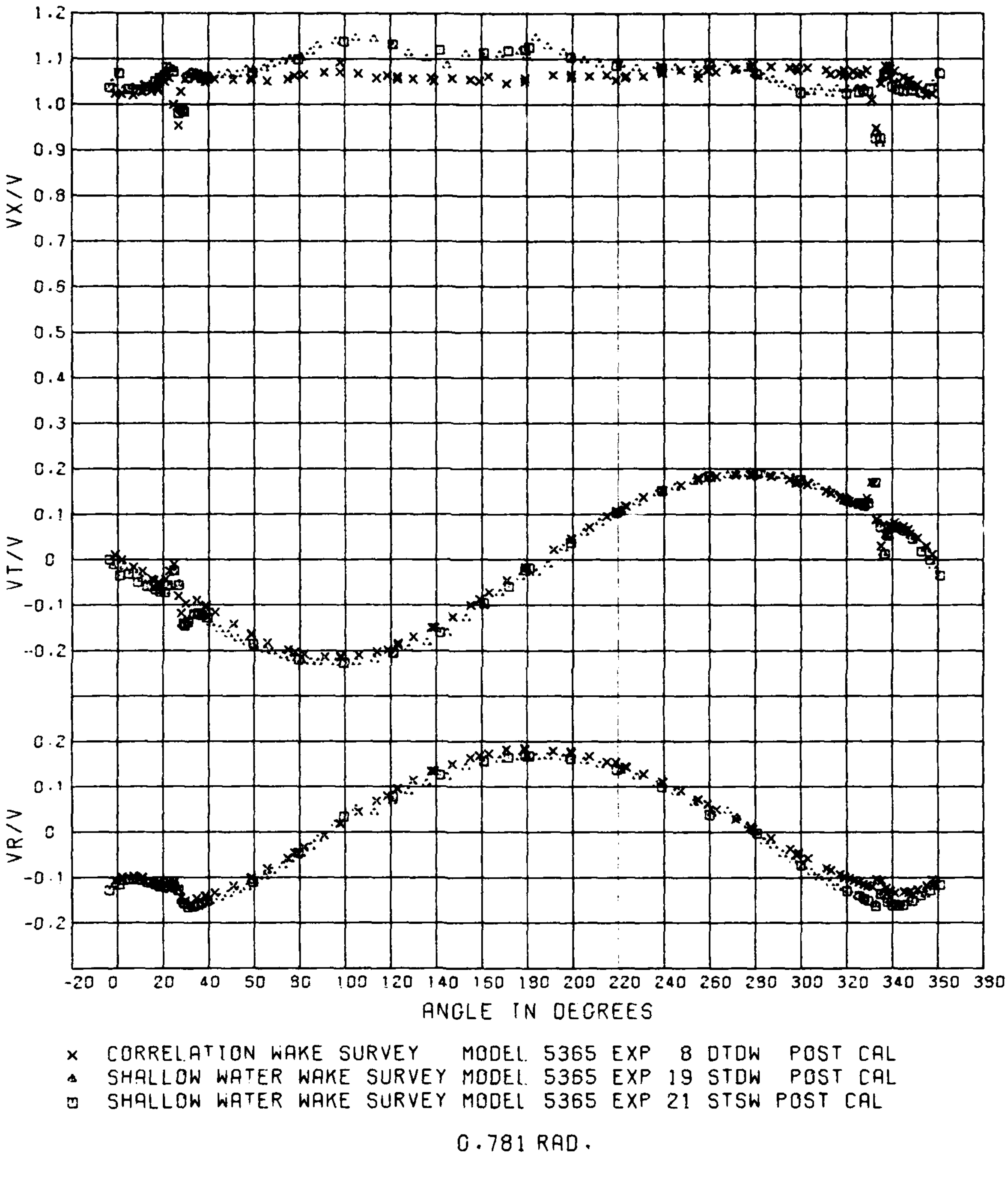


Figure 29 - Composite Plot of Velocity Component Ratios for Experiments 8, 19, and 21 for the 0.781 Radius

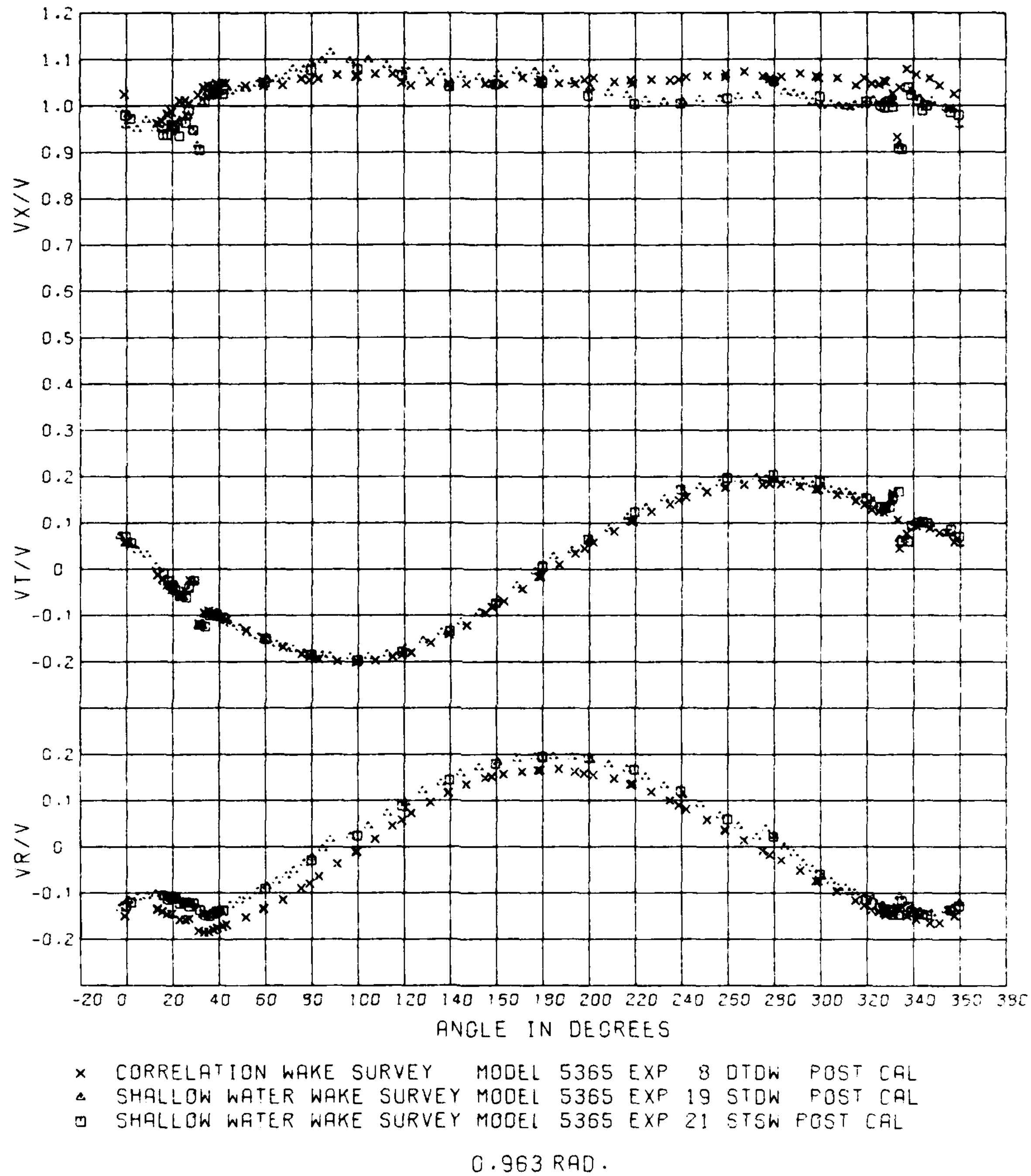
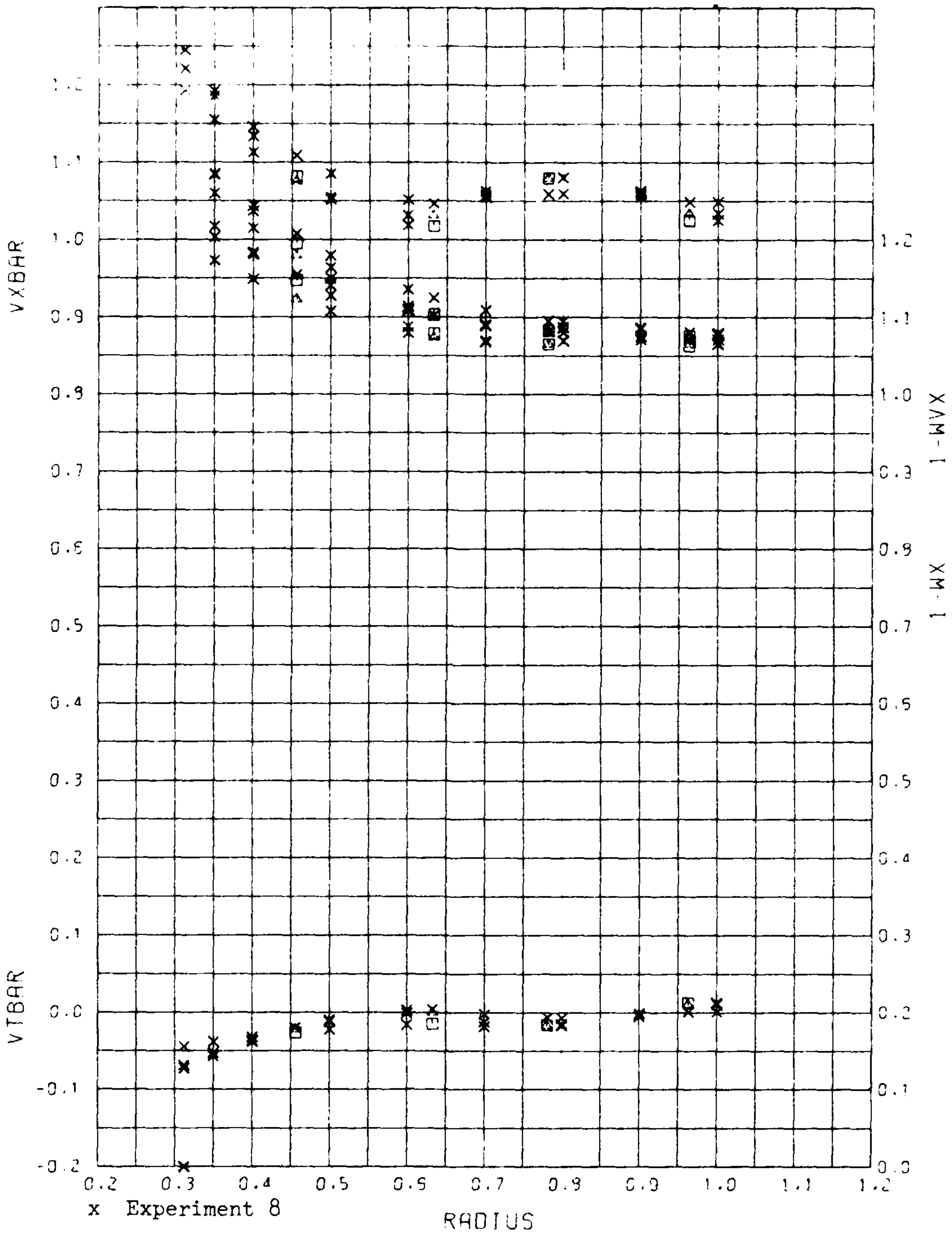


Figure 30 - Composite Plot of Velocity Component Ratios for Experiments 8, 19, and 21 for the 0.963 Radius



x Experiment 8

▲ Experiment 19

◘ Experiment 21

Figure 31 - Composite Plot of Mean Longitudinal, Tangential, and Volumetric Mean Wake of Experiments 8, 19, and 21

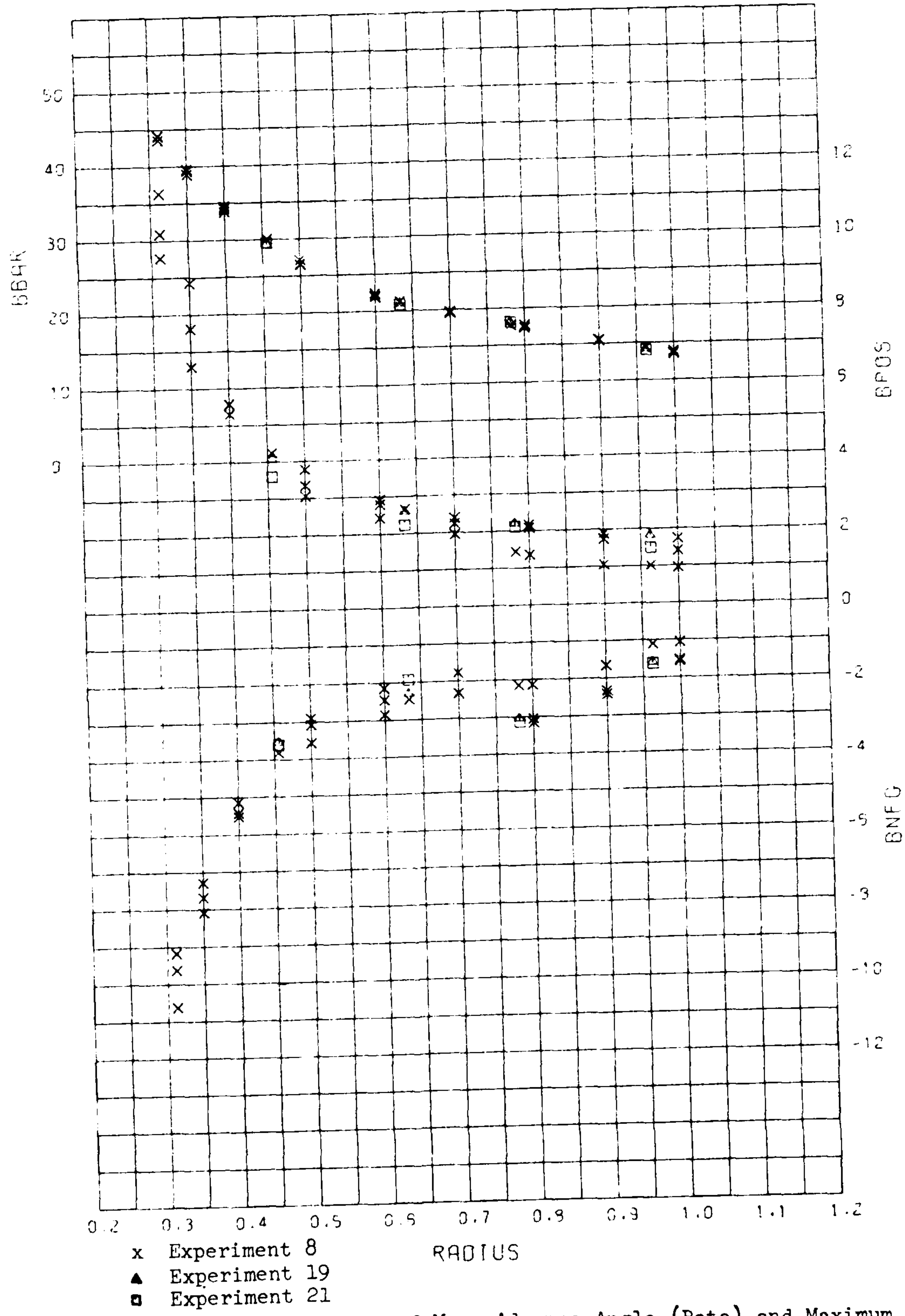


Figure 32 - Composite Plot of Mean Advance Angle (Beta) and Maximum Variations of Advance Angle of Experiments 8, 19, and 21

TABLE 1

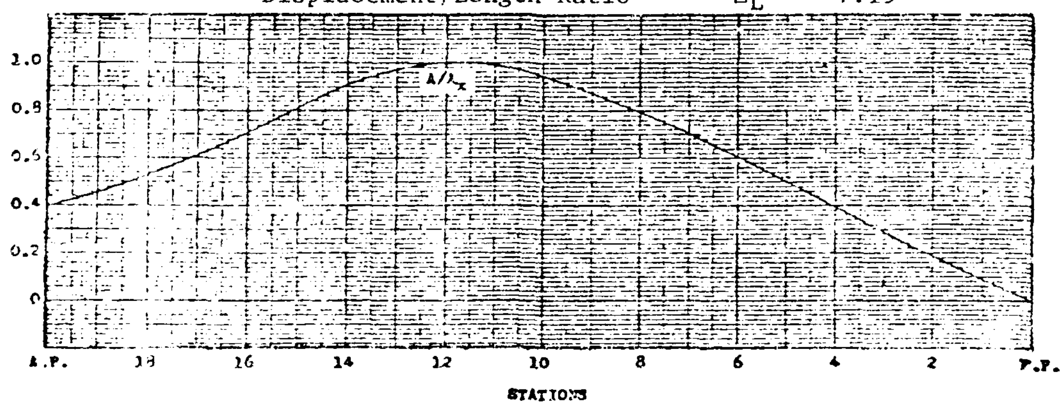
SHIP AND MODEL DATA FOR R/V ATHENA REPRESENTED BY DTNSRDC MODEL 5365

Appendages: Shafts, Vee-Struts, Rudder, Centerline Skeg, Stabilizer Fins

	Ship	Model
Length Overall	165.0 ft (50.3 m	20.01 ft (6.10 m)
Length on Waterline	154.2 ft (47.0 m)	18.70 ft (5.70 m)
Length Between Perpendiculars	153.9 ft (46.9 m)	18.67 ft (5.69 m)
Beam (Maximum)	21.9 ft (6.68 m)	2.66 ft (0.81 m)
Draft (Mean)	5.63 ft (1.72 m)	0.682 ft (0.208 m)
Displacement	263 ton (267 t)	1020 lbs (463 kg)
Wetted Surface	3,413 ft^2 (317.1 m^2)	50.16 ft^2 (4.66 m^2)

Coefficients

Scale Ratio	$\lambda = L_S/L_M$	8.25
Block Coefficient	C_B	0.48
Prismatic Coefficient	C_P	0.63
Length/Beam Ratio	L/B	7.04
Beam/Draft Ratio	B/T	3.89
Displacement/Length Ratio	Δ_L	7.15



STATIONS	0	0.5	1.0	1.5	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18.5	19	19.5	20
A/A_X	0	.04	.08	.14	.18	.28	.39	.50	.60	.70	.79	.87	.94	.99	1.0	.97	.91	.81	.71	.61	.53	.49	.46	[illegible]	0

TABLE 2

CATALOG OF EXPERIMENTS PERFORMED

EXPERIMENT NUMBER	MODEL SPEED	WATER DEPTH	TRIM SETTING SPEED	DESCRIPTION	DATA IN APPENDIX
2	5.22 knots (2.68 m/s)	Deep	5.22 knots (2.68 m/s)	Without Port Propeller	A
3	6.96 knots (3.58 m/s)	Deep	6.96 knots (3.58 m/s)	Without Port Propeller	B
4	13.50 knots (6.94 m/s)	Deep	5.22 knots (2.68 m/s)	Without Port Propeller	C
5	2.87 knots (1.48 m/s)	Deep	5.22 knots (2.68 m/s)	Without Port Propeller	D
6	2.87 knots (1.48 m/s)	Deep	5.22 knots (2.68 m/s)	With Port Propeller	E
7	5.22 knots (2.68 m/s)	Deep	5.22 knots (2.68 m/s)	Repeat of Experiment 2	A
8	5.22 knots (2.68 m/s)	Deep	5.22 knots (2.68 m/s)	With Port Propeller	F
9	6.96 knots (3.58 m/s)	Deep	6.96 knots (3.58 m/s)	Repeat of Experiment 3	B
10	6.96 knots (3.58 m/s)	Deep	6.96 knots (3.58 m/s)	With Port Propeller	*
18	5.22 knots (2.68 m/s)	Shallow and Deep	5.22 knots (2.68 m/s) Shallow Water	With Port Propeller 20 deg (0.349 rad) Increments	**
19	5.22 knots (2.68 m/s)	Deep	5.22 knots (2.68 m/s) Shallow Water	With Port Propeller	G
20	5.22 knots (2.68 m/s)	Deep	5.22 knots (2.68 m/s) Shallow Water	Without Port Propeller Two Radii	**
21	5.22 knots (2.68 m/s)	Shallow	5.22 knots (2.68 m/s) Shallow Water	With Port Propeller	H
22	5.22 knots (2.68 m/s)	Deep	5.22 knots (2.68 m/s) Shallow Water	With Port Propeller Two Radii 20 deg (0.349 rad) Increments	**

Experiments 1 and 17 were calibrations of the pressure gages. Experiments 1 through 17 were run in April 1978.

Experiments 11 through 16 inclusive were deep water towing tank wake surveys with the bass dynamometer boat and the wake screen.

Experiments 18 through 22 were run in October 1978 with a new starboard strut barrel fairing.

*The data from Experiment 10 will be presented in DTNSRDC Report SPD-0833-06.

**Experiments 18 and 22 were abbreviated experiments determining the effects of shallow water trim and an operating propeller. Experiment 22 was a repeat of Experiment 18.

TABLE 3

SUMMARY OF WAKE SURVEY EXPERIMENTAL DATA

EXPERIMENT NUMBER	2	7	3	9	4	8	19	21
CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY, V_X/V	1.059	1.044	1.080	1.064	1.079	1.059	1.080	1.080
CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY, V_T/V	-0.009	-0.002	-0.008	0.000	-0.001	-0.006	-0.017	-0.016
MEAN ADVANCE ANGLE, β	17.73	17.45	18.05	17.76	20.84	17.72	18.11	18.09
MAXIMUM POSITIVE ADVANCE ANGLE, $+\Delta\beta$	1.48	1.14	1.42	1.13	1.56	1.45	2.21	2.12
MAXIMUM NEGATIVE ADVANCE ANGLE, $-\Delta\beta$	-1.87	-0.84	-2.31	-0.98	-1.95	-2.15	-3.04	-3.14
FIRST LONGITUDINAL HARMONIC	0.0182	0.0152	0.0103	0.0196	0.0279	0.0102	0.0456	0.0512
SECOND LONGITUDINAL HARMONIC	0.0143	0.0191	0.0147	0.0151	0.0122	0.0145	0.0139	0.0105
THIRD LONGITUDINAL HARMONIC	0.0093	0.0075	0.0093	0.0069	0.0099	0.0066	0.0031	0.0059
FOURTH LONGITUDINAL HARMONIC	0.0017	0.0022	0.0025	0.0056	0.0043	0.0024	0.0144	0.0124
FIRST TANGENTIAL HARMONIC	0.1950	0.1885	0.1932	0.1873	0.1404	0.1981	0.2111	0.2092
SECOND TANGENTIAL HARMONIC	0.0016	0.0030	0.0037	0.0015	0.0094	0.0070	0.0030	0.0014
THIRD TANGENTIAL HARMONIC	0.0022	0.0020	0.0042	0.0044	0.0049	0.0035	0.0039	0.0044
FOURTH TANGENTIAL HARMONIC	0.0019	0.0016	0.0027	0.0021	0.0010	0.0022	0.0013	0.0028

All data for r/R = 0.781 Radius

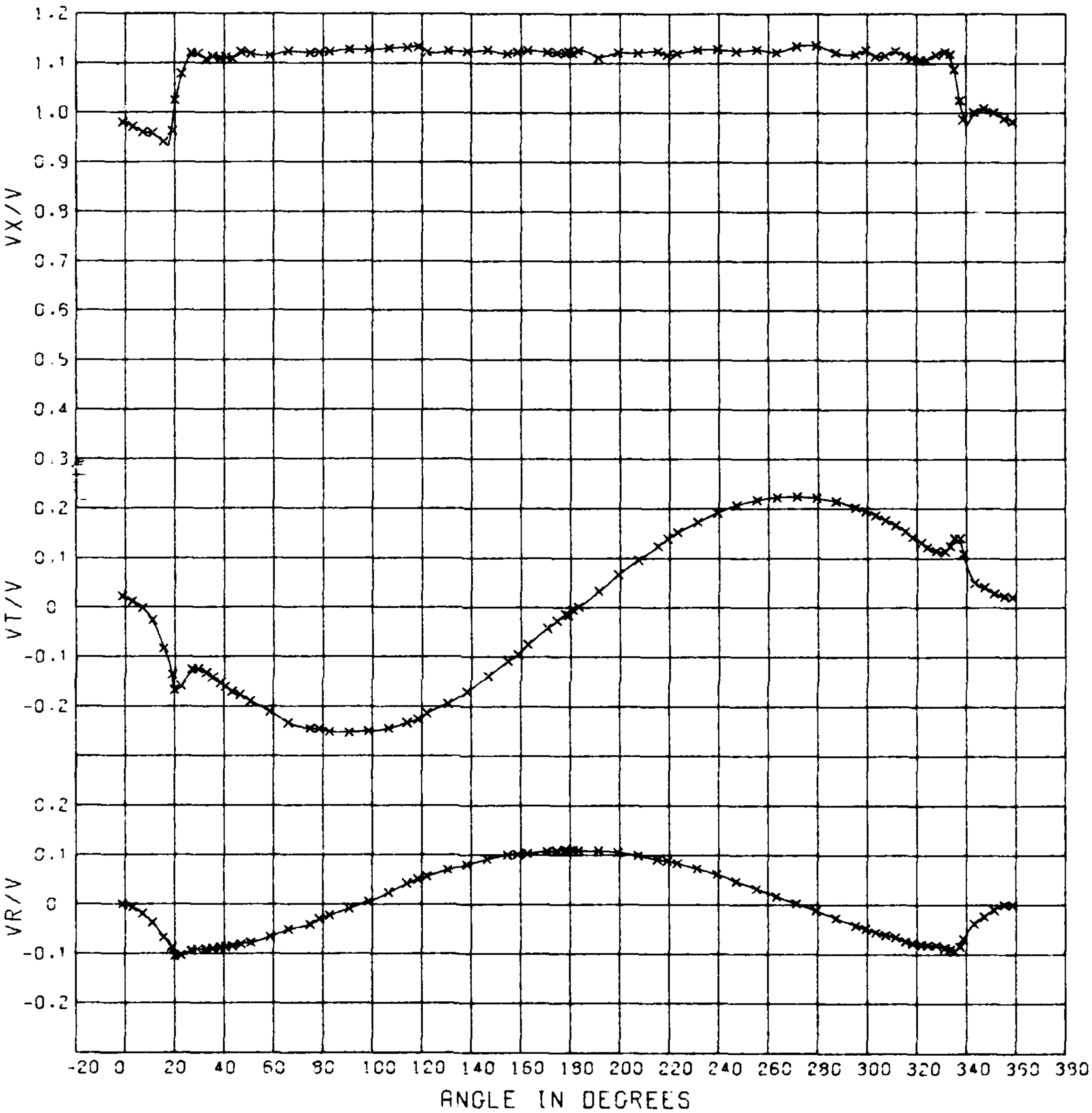
TABLE 4
EFFECT OF SPEED ON THE CIRCUMFERENTIAL MEAN VELOCITIES, MEAN ADVANCE ANGLE AND ITS VARIATIONS, AND THE FIRST FOUR HARMONICS

EXPERIMENT NUMBER	5	2	3	4
SPEED CONDITIONS	2.87 knots (1.48 m/s)	5.22 knots (2.68 m/s)	6.96 knots (3.58 m/s)	13.5 knots (6.94 m/s)
CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY, V_X/V	1.030	1.059	1.080	1.079
CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY, V_T/V	-0.002	-0.009	-0.008	-0.001
MEAN ADVANCE ANGLE, β	17.24	17.73	18.05	20.84
MAXIMUM POSITIVE ADVANCE ANGLE, $+\Delta\beta$	1.10	1.48	1.42	1.56
MAXIMUM NEGATIVE ADVANCE ANGLE, $-\Delta\beta$	-1.85	-1.87	-2.31	-1.95
FIRST LONGITUDINAL HARMONIC	0.0248	0.0182	0.0103	0.0279
SECOND LONGITUDINAL HARMONIC	0.0185	0.0143	0.0147	0.0122
THIRD LONGITUDINAL HARMONIC	0.0079	0.0093	0.0093	0.0099
FOURTH LONGITUDINAL HARMONIC	0.0047	0.0017	0.0025	0.0043
FIRST TANGENTIAL HARMONIC	0.1966	0.1950	0.1932	0.1404
SECOND TANGENTIAL HARMONIC	0.0054	0.0016	0.0037	0.0094
THIRD TANGENTIAL HARMONIC	0.0021	0.0022	0.0042	0.0049
FOURTH TANGENTIAL HARMONIC	0.0022	0.0019	0.0027	0.0010

All data for r/R = 0.781 Radius

APPENDIX A

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS FOR EXPERIMENTS 2 AND 7



VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 2

0.456 RAD.

Figure A-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 2

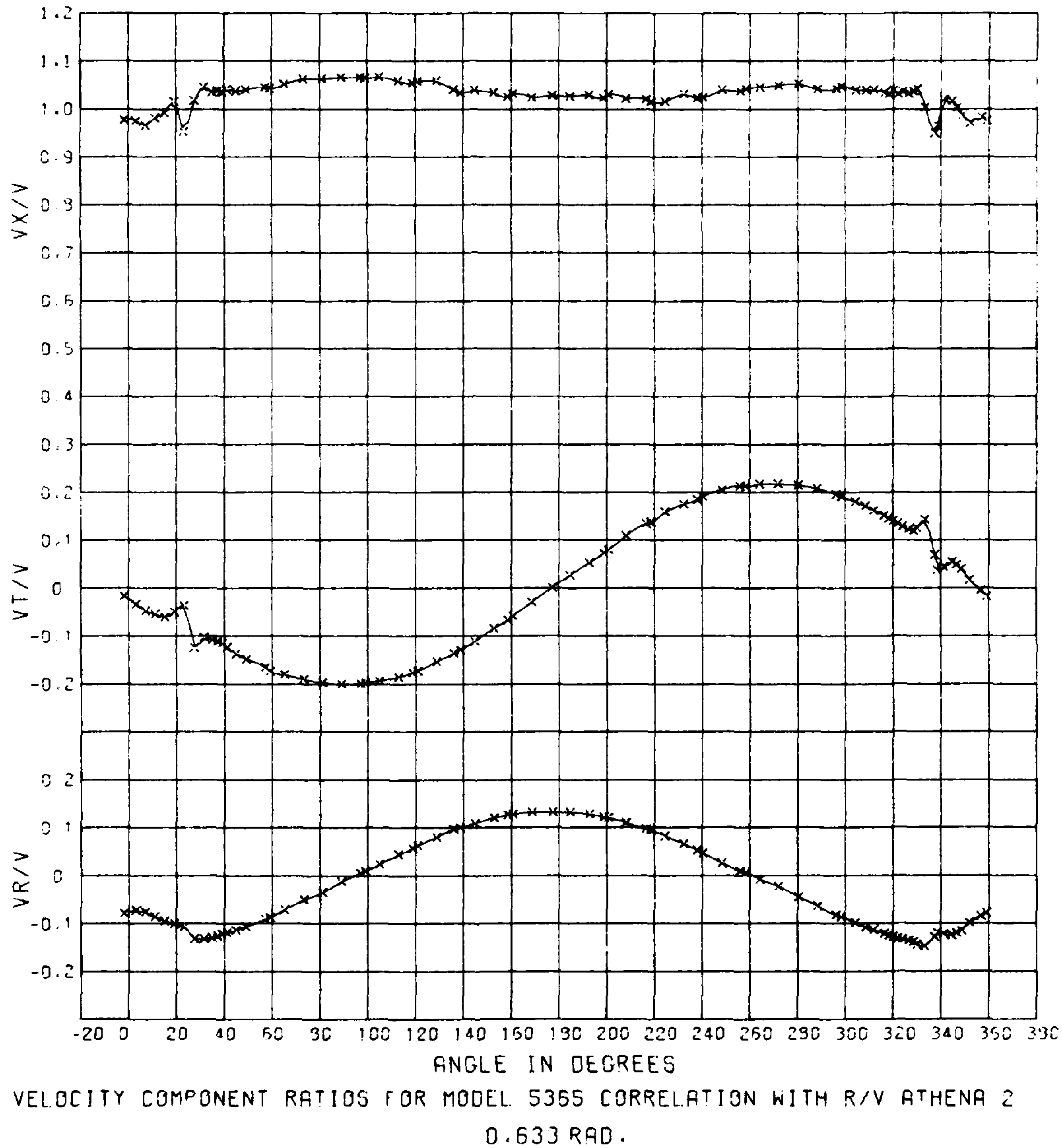


Figure A-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 2

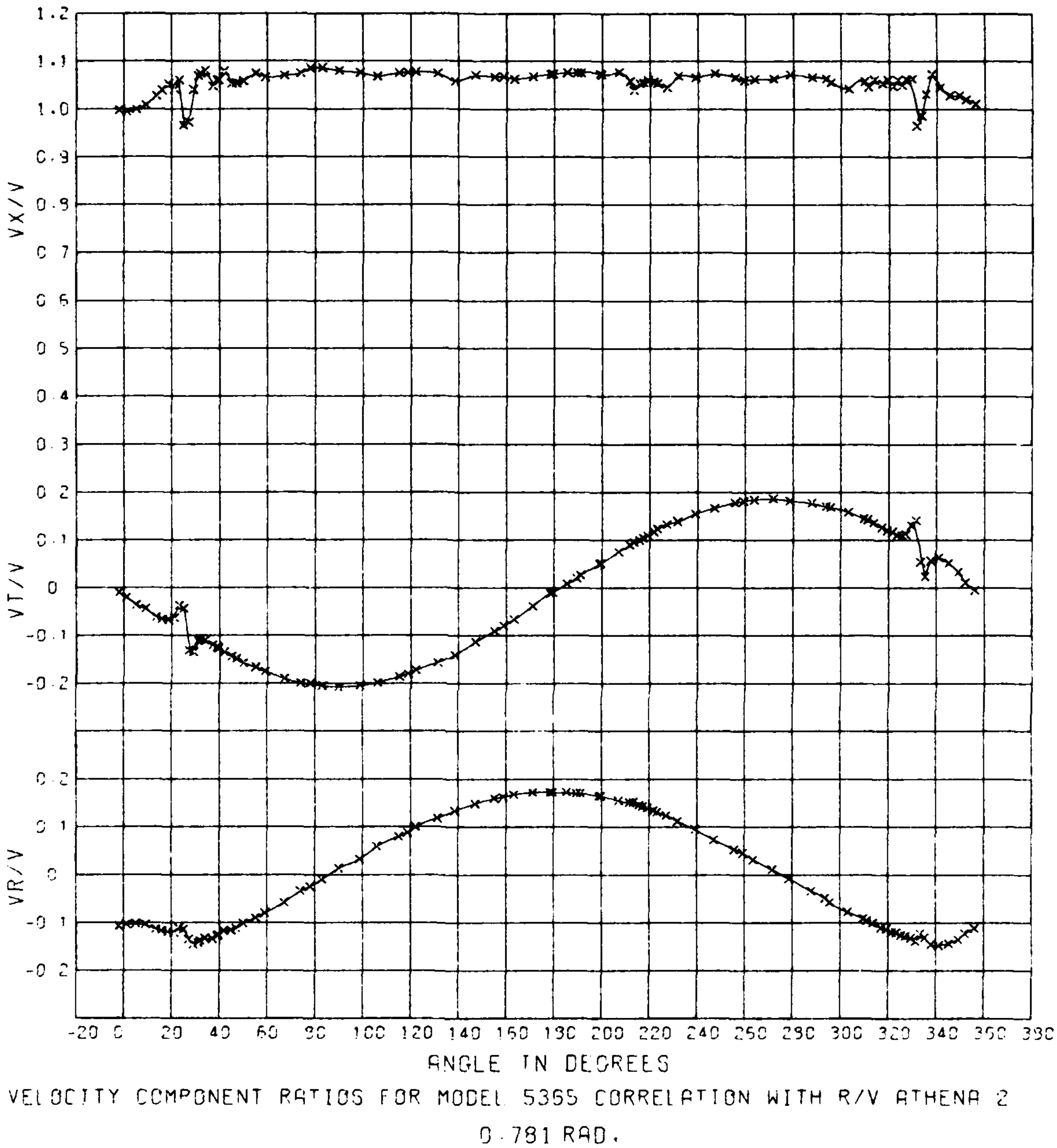


Figure A-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 2

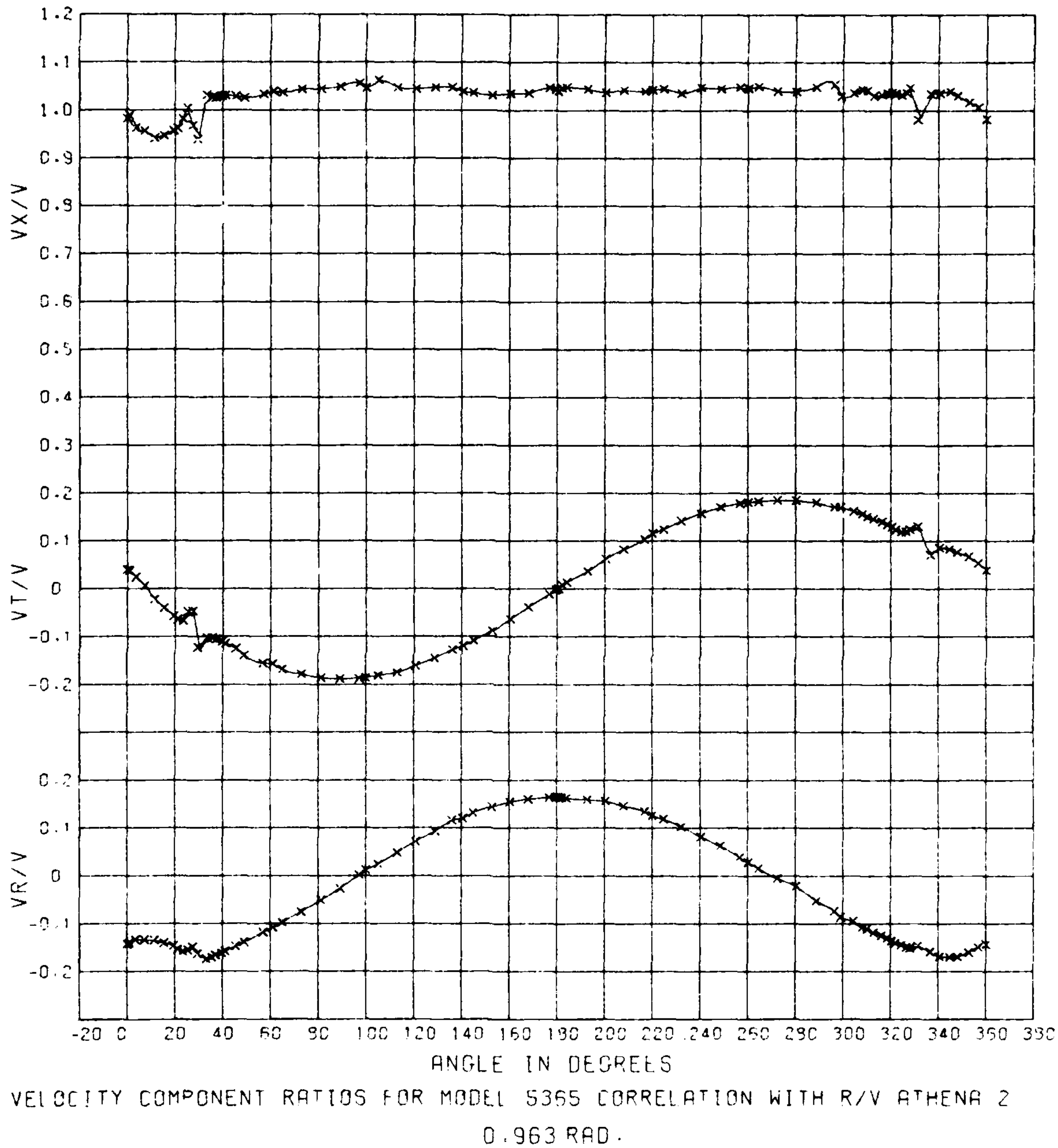


Figure A-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 2

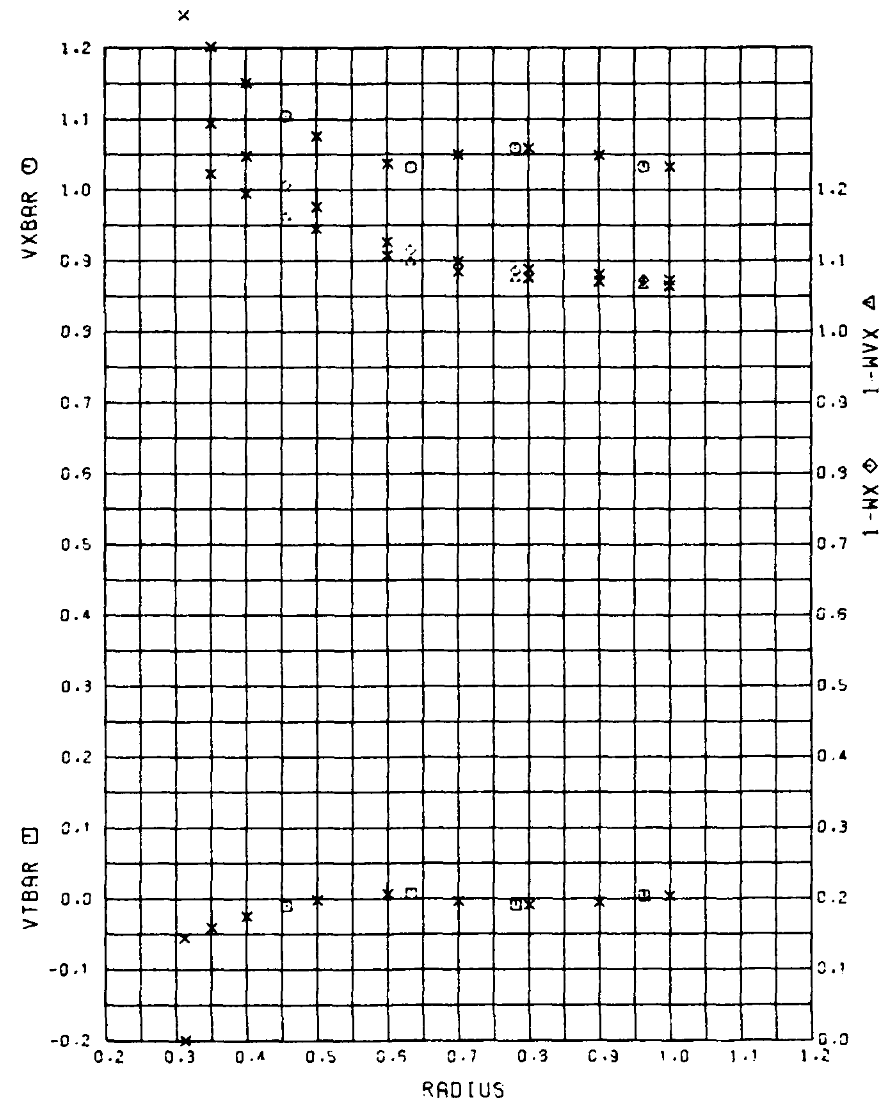


Figure A-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 2

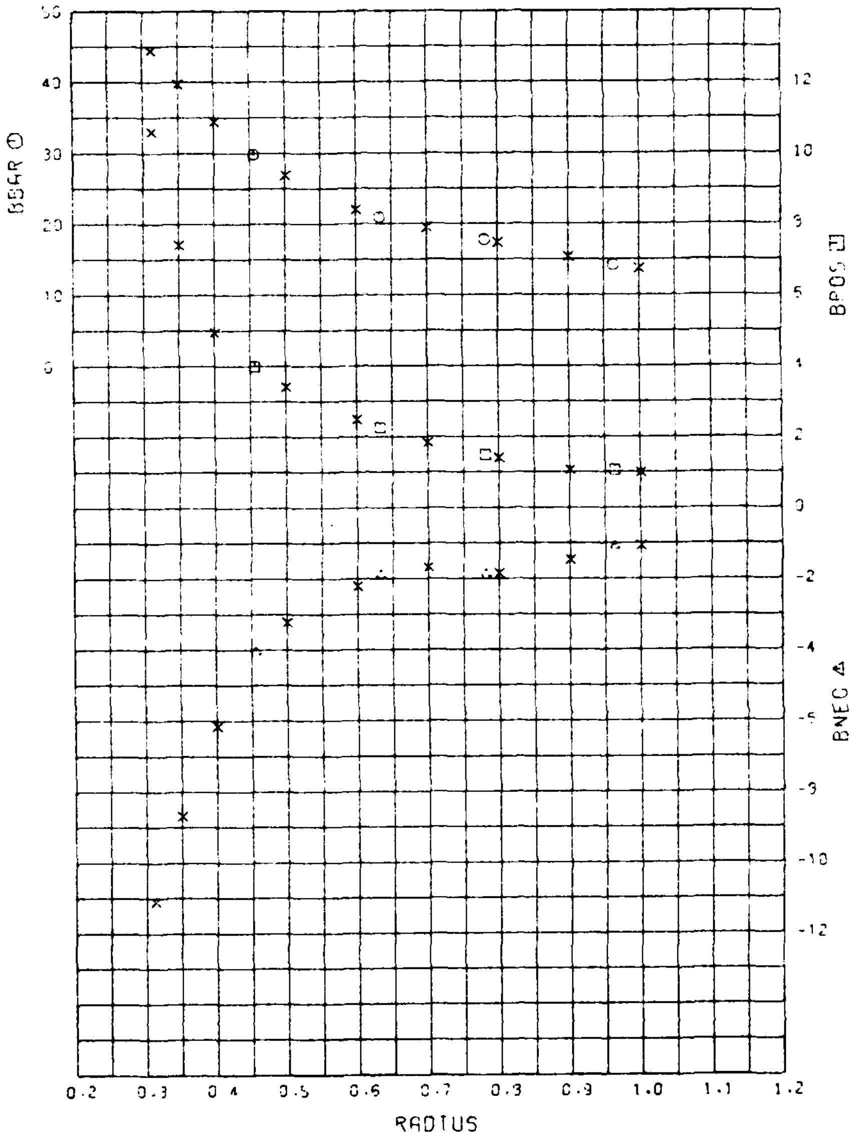


Figure A-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 2

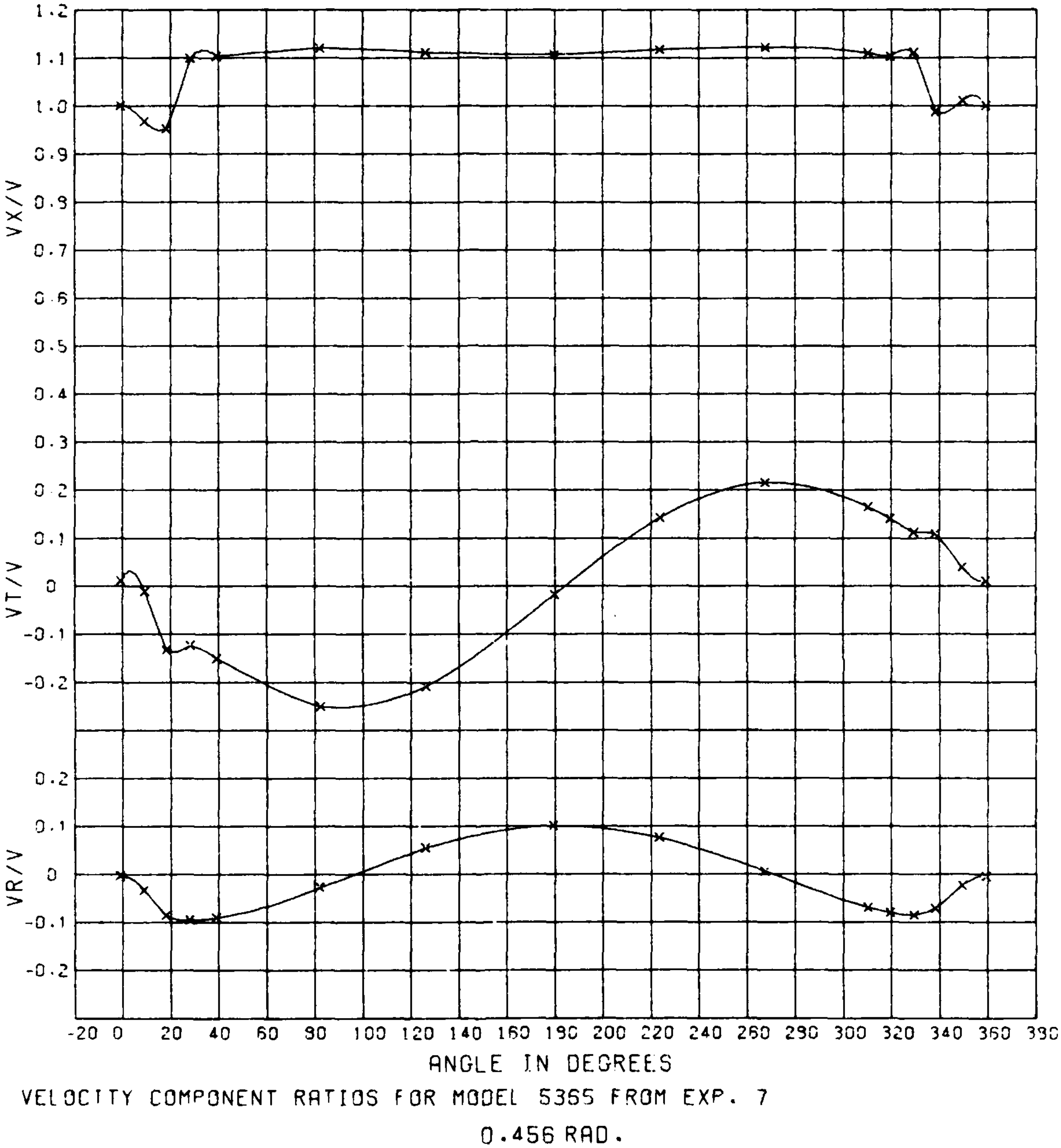


Figure A-7 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 7

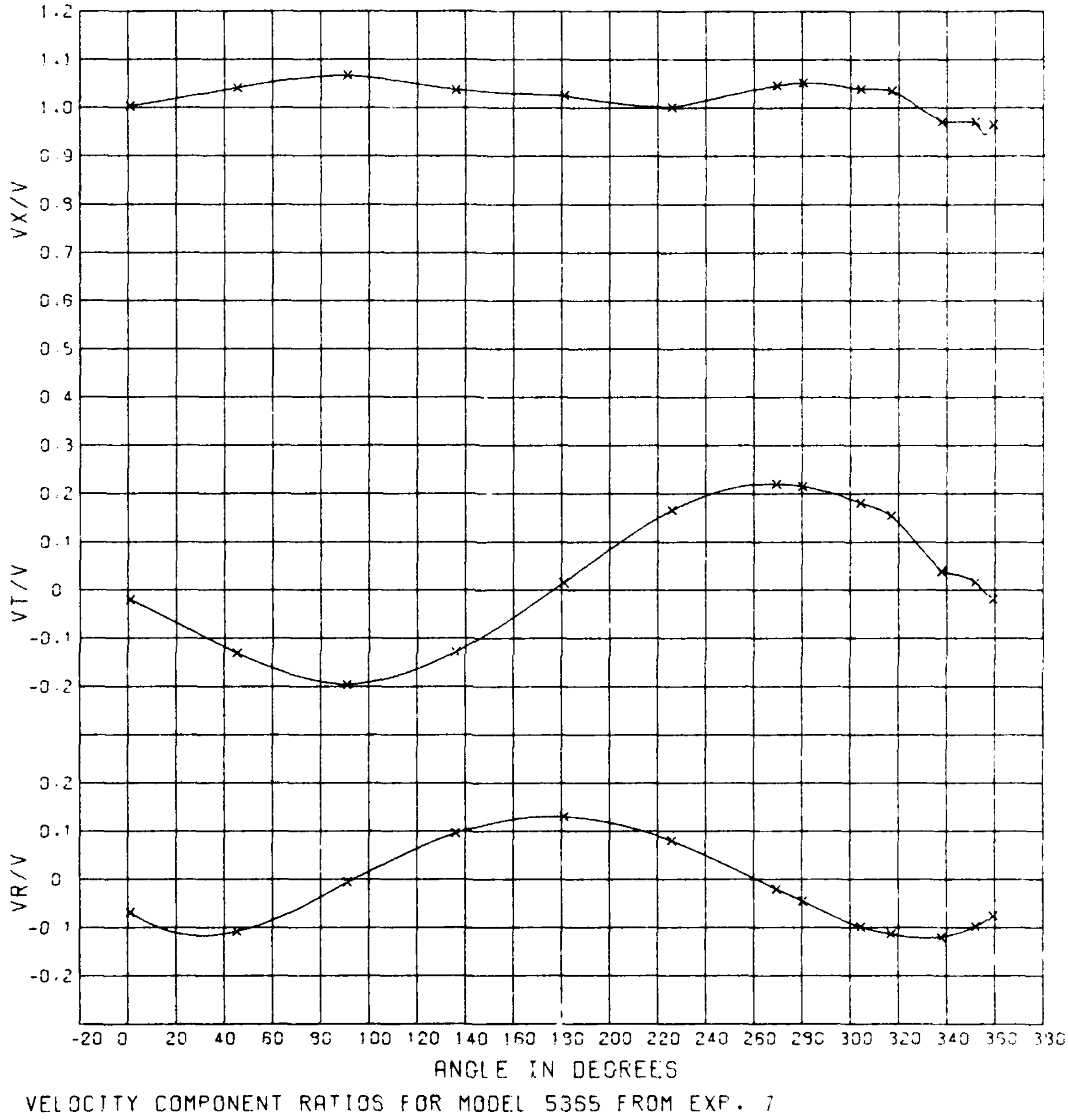


Figure A-8 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 7

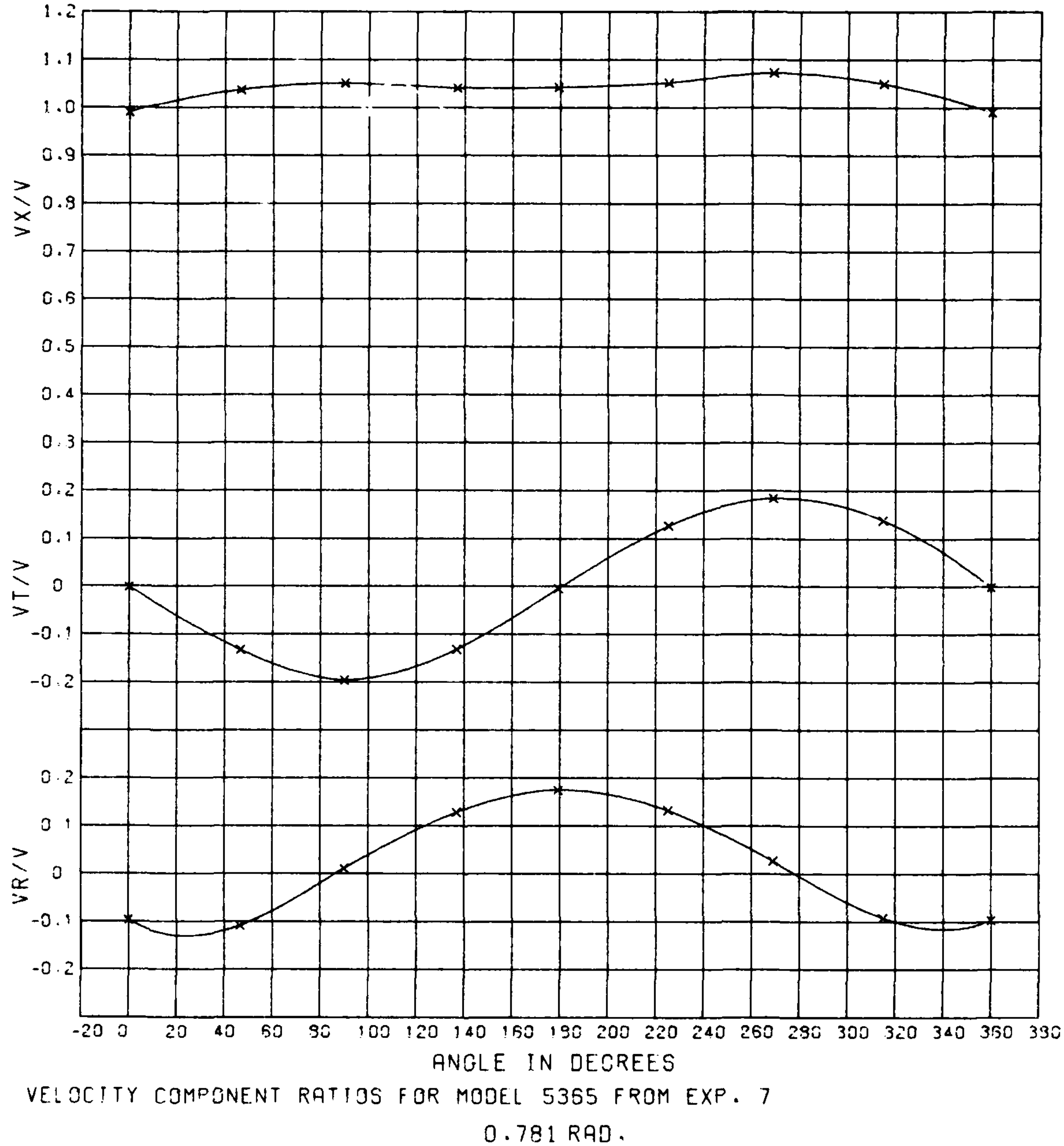


Figure A-9 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 7

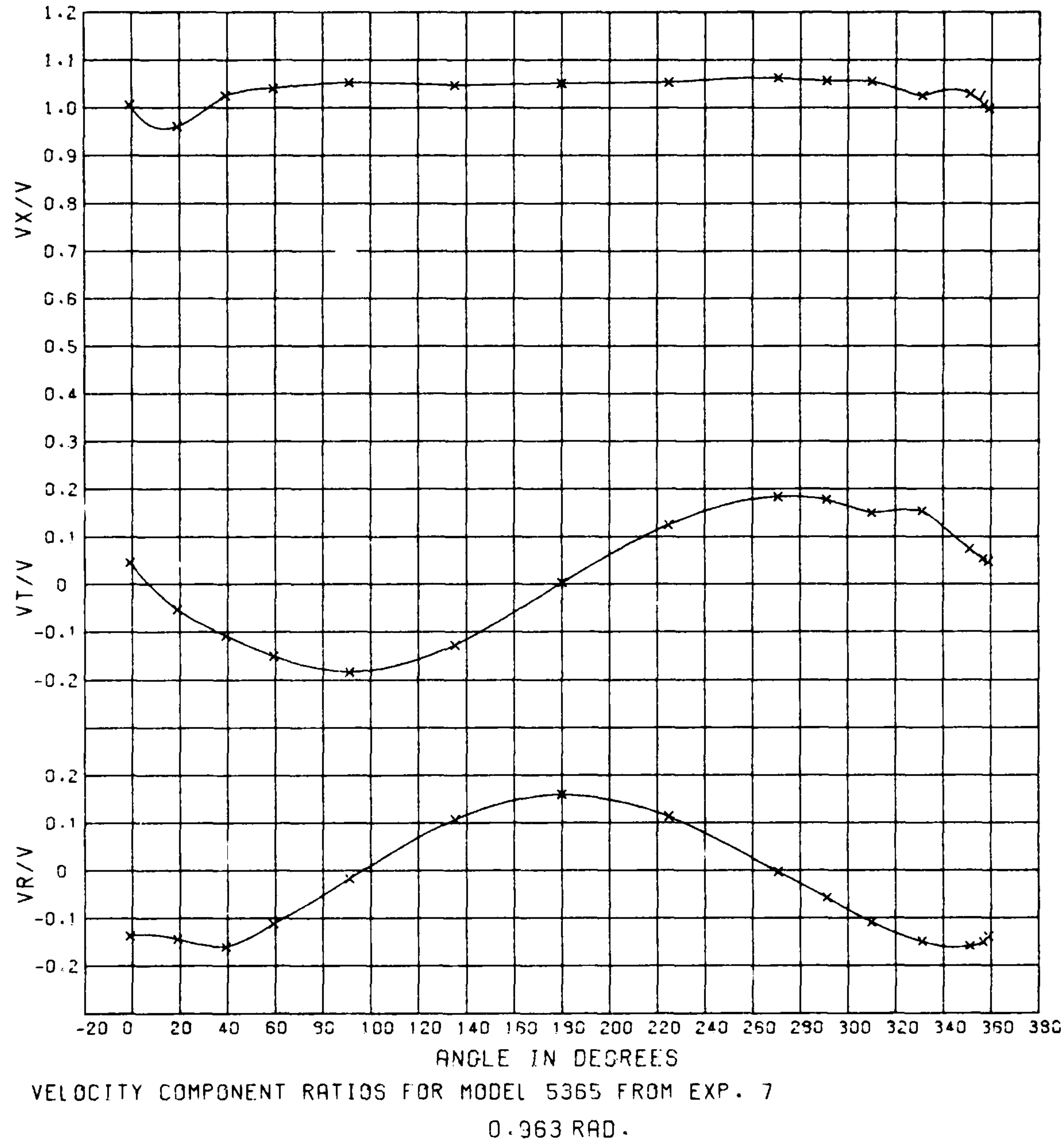


Figure A-10 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 7

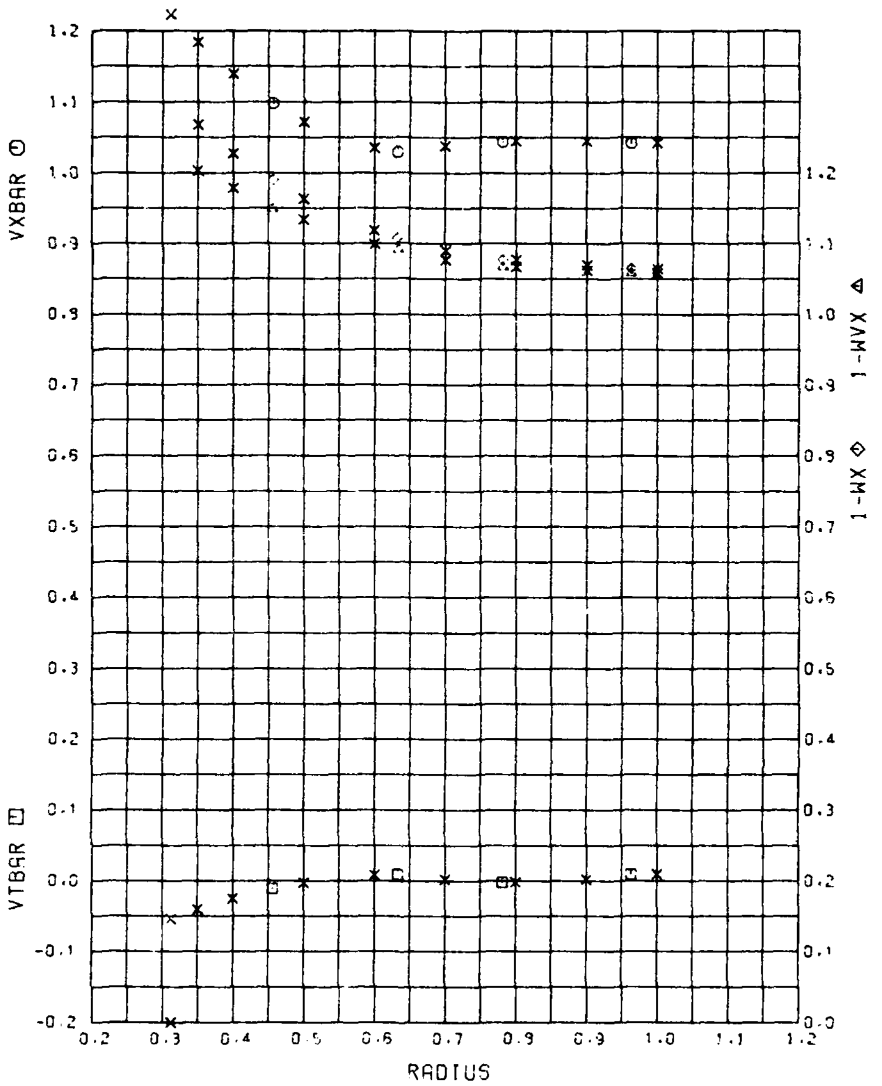


Figure A-11 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 7

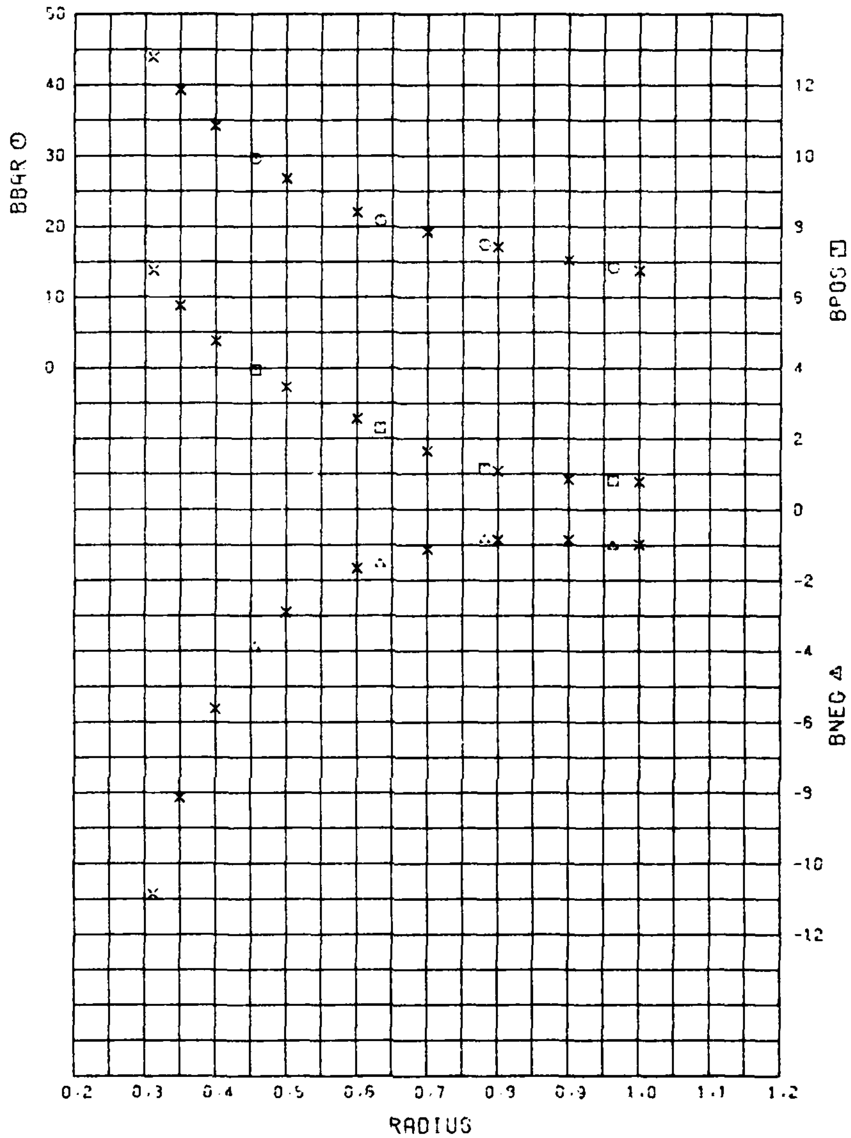


Figure A-12 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations of Experiment 7

TABLE A-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 2

ANGLE	RADIUS = .456 VX/V	VT/V	VR/V
-1.0	.981	.022	-.001
3.0	.972	.013	-.006
7.0	.968	-.002	-.019
11.0	.959	-.026	-.037
14.9	.969	-.066	-.058
16.0	.933	-.106	-.076
18.8	.967	-.135	-.085
18.9	.958	-.159	-.089
20.0	1.025	-.167	-.105
22.8	1.079	-.158	-.103
26.8	1.121	-.126	-.096
28.9	1.125	-.176	-.091
30.0	1.115	-.127	-.091
32.8	1.107	-.133	-.092
34.7	1.116	-.138	-.098
36.0	1.113	-.145	-.089
36.7	1.114	-.153	-.086
38.8	1.105	-.153	-.089
40.7	1.113	-.160	-.087
42.7	1.109	-.168	-.086
44.0	1.110	-.173	-.046
46.7	1.124	-.177	-.081
50.8	1.119	-.190	-.070
54.6	1.115	-.211	-.065
66.0	1.125	-.234	-.051
74.7	1.121	-.245	-.041
78.5	1.122	-.246	-.030
82.6	1.123	-.252	-.023
90.6	1.128	-.253	-.009
98.6	1.125	-.248	.006
98.5	1.129	-.252	.008
106.6	1.131	-.245	.024
116.0	1.132	-.233	.042
118.5	1.134	-.226	.051
122.0	1.123	-.214	.057
130.6	1.126	-.195	.069
134.0	1.121	-.171	.078
138.6	1.125	-.169	.081
146.5	1.127	-.139	.091
154.5	1.120	-.109	.100
158.6	1.123	-.095	.101
162.6	1.127	-.076	.103
170.6	1.123	-.042	.107
174.5	1.122	-.027	.108
178.0	1.113	-.016	.110
178.0	1.129	-.015	.112
179.0	1.122	-.020	.105
179.3	1.126	-.012	.110
180.7	1.120	-.005	.110
181.0	1.121	-.005	.110
183.1	1.127	.002	.109
191.3	1.111	.036	.109
199.0	1.120	.067	.106
199.2	1.117	.068	.105
207.3	1.121	.097	.100
215.2	1.175	.175	.091
219.2	1.117	.140	.089
223.2	1.115	.152	.083
223.2	1.125	.152	.085
231.3	1.178	.173	.073
239.3	1.129	.192	.062
247.0	1.126	.207	.047
255.2	1.178	.217	.032
263.2	1.173	.272	.017
271.2	1.130	.273	.003
271.3	1.140	.225	.002
279.2	1.137	.227	-.012
287.1	1.122	.219	-.027
295.1	1.118	.202	-.042
299.2	1.127	.195	-.048
303.2	1.114	.187	-.059
307.1	1.118	.177	-.061
311.1	1.126	.166	-.065
315.1	1.116	.156	-.076
318.0	1.110	.142	-.070
318.0	1.112	.143	-.077
321.1	1.100	.135	-.079
322.0	1.106	.129	-.081
326.0	1.107	.122	-.082
327.0	1.111	.117	-.082
328.0	1.125	.113	-.081
331.1	1.123	.116	-.087
331.3	1.125	.116	-.087
333.2	1.126	.126	-.091
333.3	1.110	.126	-.090
335.0	1.080	.140	-.096
337.1	1.031	.140	-.083
337.2	1.021	.140	-.089
338.0	.989	.107	-.070
339.0	.985	.111	-.067
343.0	1.001	.050	-.030
347.0	1.001	.039	-.026
347.0	1.017	.044	-.022
351.0	1.001	.029	-.010
355.1	.980	.023	0.000
358.0	.986	.020	.001
359.0	.981	.022	-.001

ANGLE	RADIUS = .633 VX/V	VT/V	VR/V
-1.7	.977	-.017	-.079
3.1	.975	-.034	-.073
7.1	.966	-.047	-.076
11.1	.982	-.053	-.046
15.2	.992	-.060	-.045
19.2	1.005	-.051	-.099
19.2	1.027	-.049	-.102
21.2	.953	-.036	-.107
27.2	.994	-.131	-.130
28.0	1.041	-.110	-.133
31.0	1.041	-.106	-.133
32.0	1.051	-.107	-.131
35.0	1.035	-.108	-.129
37.2	1.030	-.112	-.126
39.2	1.079	-.112	-.119
39.2	1.061	-.117	-.123
41.2	1.061	-.176	-.119
45.0	1.030	-.137	-.116
49.2	1.041	-.148	-.107
57.2	1.045	-.165	-.090
59.2	1.042	-.173	-.087
65.2	1.052	-.181	-.071
73.1	1.063	-.190	-.051
81.0	1.063	-.197	-.035
89.0	1.066	-.201	-.012
97.0	1.065	-.200	.006
99.0	1.066	-.198	.010
106.9	1.067	-.196	.026
112.9	1.059	-.186	.045
118.8	1.055	-.176	.057
120.9	1.057	-.172	.063
128.8	1.059	-.153	.080
136.0	1.061	-.136	.097
138.7	1.035	-.129	.099
144.7	1.039	-.111	.109
152.7	1.035	-.083	.121
158.6	1.026	-.066	.126
158.7	1.032	-.058	.128
168.6	1.026	-.029	.133
176.4	1.032	0.000	.133
178.0	1.025	.006	.132
186.6	1.026	.027	.132
192.6	1.030	.053	.128
198.6	1.026	.073	.122
200.6	1.031	.090	.121
208.0	1.022	.109	.110
216.5	1.020	.135	.097
218.5	1.015	.137	.095
226.4	1.016	.159	.082
232.4	1.032	.176	.066
239.0	1.023	.185	.053
240.6	1.024	.192	.047
248.3	1.040	.205	.026
256.0	1.038	.216	.010
258.0	1.039	.218	.013
258.7	1.046	.215	.001
264.2	1.045	.218	-.008
272.0	1.049	.218	-.023
280.3	1.053	.215	-.045
288.3	1.061	.209	-.064
296.2	1.062	.196	-.082
298.6	1.067	.192	-.086
304.3	1.048	.181	-.099
308.6	1.040	.172	-.107
312.0	1.041	.162	-.113
316.6	1.035	.153	-.121
318.0	1.032	.140	-.125
318.6	1.029	.146	-.129
320.0	1.038	.141	-.128
322.0	1.031	.135	-.131
326.0	1.037	.129	-.132
326.5	1.032	.123	-.135
328.5	1.037	.120	-.137
330.0	1.042	.126	-.144
332.6	1.038	.141	-.148
334.0	.971	.145	-.147
334.6	.929	.100	-.135
338.0	.972	.039	-.120
338.5	.986	.038	-.119
340.6	1.020	.038	-.120
342.0	1.022	.053	-.124
344.6	1.017	.055	-.125
346.6	1.003	.049	-.120
349.7	.987	.040	-.115
352.0	.972	.017	-.098
356.7	.986	-.006	-.085
358.7	.975	-.019	-.078
359.3	.977	-.017	-.079

ANGLE	RADIUS = .781 VX/V	VT/V	VR/V
-2.0	.990	-.010	-.100
1.2	.996	-.020	-.106
5.1	.999	-.037	-.103
9.1	1.008	-.044	-.106
13.1	1.026	-.060	-.112
14.0	1.028	-.063	-.116
16.0	1.039	-.066	-.117
18.0	1.049	-.060	-.118
19.1	1.054	-.060	-.118
21.1	1.041	-.063	-.121
23.1	1.060	-.037	-.111
25.0	.966	-.044	-.116
27.1	.965	-.131	-.136
27.1	.981	-.131	-.136
29.0	1.040	-.136	-.145
31.1	1.065	-.112	-.142
31.1	1.071	-.111	-.141
32.0	1.074	-.108	-.137
36.0	1.080	-.110	-.137
37.1	1.047	-.120	-.136
38.8	1.065	-.126	-.127
39.1	1.054	-.125	-.129
39.1	1.060	-.126	-.127
40.0	1.061	-.130	-.124
42.0	1.078	-.135	-.117
45.0	1.053	-.143	-.117
47.0	1.056	-.140	-.112
50.0	1.050	-.157	-.102
55.1	1.074	-.166	-.091
59.0	1.060	-.175	-.082
59.2	1.072	-.175	-.079
67.1	1.070	-.190	-.058
76.0	1.076	-.199	-.036
78.0	1.085	-.200	-.025
83.0	1.086	-.205	-.010
90.0	1.080	-.208	.016
98.6	1.087	-.202	.030
99.0	1.064	-.208	.035
106.0	1.068	-.199	.059
115.1	1.075	-.196	.080
118.7	1.076	-.181	.088
127.0	1.077	-.177	.100
131.1	1.076	-.157	.118
139.0	1.054	-.140	.134
138.7	1.061	-.141	.134
147.0	1.071	-.113	.149
155.0	1.067	-.090	.160
158.7	1.068	-.079	.157
163.1	1.062	-.066	.160
171.0	1.068	-.038	.172
178.0	1.069	-.011	.176
178.8	1.076	-.012	.172
179.3	1.073	-.010	.172
189.3	1.076	.008	.173
189.6	1.076	.020	.171
191.0	1.076	.027	.171
198.9	1.072	.049	.166
199.2	1.075	.050	.166
199.6	1.072	.051	.165
207.0	1.077	.075	.155
211.5	1.059	.090	.151
213.2	1.039	.096	.152
215.5	1.056	.100	.148
217.0	1.056	.105	.143
219.0	1.056	.110	.141
219.1	1.067	.108	.138
221.5	1.057	.117	.136
223.0	1.095	.126	.131
227.0	1.065	.133	.125
231.0	1.069	.138	.112
239.0	1.063	.155	.096
239.0	1.069	.156	.093
247.0	1.074	.166	.073
255.6	1.066	.170	.053
259.2	1.060	.182	.046
263.6	1.062	.185	.032
271.6	1.063	.187	.011
278.0	1.068	.186	-.005
279.0	1.077	.181	-.011
287.7	1.066	.177	-.036
293.5	1.063	.170	-.049
295.5	1.058	.169	-.058
303.0	1.042	.150	-.077
309.6	1.058	.145	-.091
311.2	1.046	.142	-.098
313.5	1.061	.136	-.100
317.0	1.054	.126	-.110
319.0	1.061	.121	-.111
319.5	1.062	.120	-.113
321.6	1.060	.110	-.120
323.1	1.061	.110	-.121
325.2	1.040	.110	-.124
325.3	1.059	.108	-.129
327.0	1.062	.111	-.128
329.6	1.063	.130	-.131
331.3	.966	.141	-.130
333.3	.987	.096	-.122
335.2	1.031	.026	-.131
337.3	1.076	.049	-.143
339.0	1.072	.066	-.147
341.0	1.065	.083	-.147
345.1	1.079	.092	-.143
349.2	1.078	.033	-.135
352.0	1.070	.011	-.127
356.0	1.011	-.005	-.112
359.0	.998	-.018	-.100

ANGLE	RADIUS = .963 VX/V	VT/V	VR/V
0.0	.980	.040	-.165
0.0	.984	.037	-.161
.9	.988	.037	-.160
3.4	.962	.024	-.136
7.3	.957	.006	-.134
11.4	.942	-.022	-.135
15.4	.947	-.040	-.141
19.4	.957	-.057	-.146
21.1	.962	-.064	-.154
23.4	.982	-.067	-.158
25.4	1.003	-.040	-.156
27.4	.957	-.067	-.147
27.4	.979	-.067	-.151
29.4	.939	-.123	-.163
33.3	1.031	-.103	-.174
35.4	1.026	-.103	-.171
37.0	1.026	-.106	-.167
39.5	1.030	-.110	-.162
41.0	1.032	-.116	-.157
41.1	1.029	-.115	-.159
45.4	1.029	-.125	-.140
49.0	1.025	-.140	-.139
57.0	1.033	-.156	-.118
61.1	1.039	-.157	-.109
65.0	1.036	-.169	-.098
73.0	1.043	-.179	-.076
81.1	1.042	-.187	-.067
81.3	1.046	-.185	-.055
89.1	1.047	-.189	-.031
99.1	1.050	-.188	-.023
97.2	1.056	-.188	.002
100.0	1.046	-.187	.017
105.1	1.063	-.182	.024
113.1	1.047	-.176	.049
120.7	1.037	-.163	.072
121.0	1.052	-.160	.071
128.9	1.047	-.145	.093
136.0	1.040	-.127	.116
140.5	1.039	-.120	.119
144.8	1.037	-.109	.131
152.8	1.031	-.088	.144
160.0	1.030	-.064	.156
160.8	1.040	-.063	.157
168.0	1.036	-.038	.160
176.7	1.047	-.012	.163
178.8	1.042	-.006	.165
180.0	1.045	.002	.164
180.5	1.040	.000	.165
182.0	1.047	.009	.163
184.0	1.048	.016	.167
192.8	1.044	.036	.159
200.0	1.041	.061	.155
200.8	1.033	.063	.156
208.0	1.043	.083	.164
216.7	1.040	.106	.135
220.0	1.043	.116	.126
224.6	1.045	.124	.118
237.0	1.035	.162	.103
240.3	1.047	.157	.091
248.6	1.045	.171	.067
256.6	1.048	.178	.039
260.2	1.046	.181	.029
264.5	1.050	.183	.016
272.4	1.041	.186	-.006
280.1	1.042	.185	-.023
280.4	1.036	.185	-.021
288.7	1.049	.181	-.052
296.4	1.056	.172	-.074
299.0	1.079	.171	-.086
304.4	1.036	.162	-.094
308.0	1.042	.156	-.108
310.0	1.042	.151	-.110
312.7	1.030	.146	-.120
316.0	1.034	.141	-.125
316.4	1.032	.140	-.124
319.5	1.036	.134	-.131
320.2	1.031	.131	-.134
320.5	1.044	.120	-.135
322.0	1.035	.124	-.140
324.5	1.032	.119	-.144
328.5	1.037	.119	-.149
328.0	1.067	.124	-.151
330.6	1.019	.150	-.153
332.0	.967	.110	-.161
336.6	1.015	.071	-.158
340.3	1.032	.049	-.169
340.6	1.039	.046	-.168
344.7	1.040	.043	-.170
348.0	1.031	.077	-.170
352.0	1.017	.067	-.160
356.0	1.007	.053	-.150
360.0	.986	.037	-.161
360.0	.980	.040	-.165

TABLE A-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 2

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 2 WITHOUT PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	1.105	1.032	1.059	1.033	1.247	1.202	1.151	1.076	1.037	1.050	1.059	1.049	1.033
VTBAR =	-.010	.007	-.009	.004	-.055	-.041	-.025	-.002	.007	-.003	-.009	-.005	.004
VRBAR =	.009	-.007	.014	-.006	.055	.040	.023	.001	-.007	.007	.014	.007	-.006
1-WVX =	1.162	1.098	1.075	1.065	0.000	1.223	1.195	1.145	1.107	1.085	1.076	1.071	1.065
1-WX =	1.207	1.115	1.086	1.073	0.000	1.294	1.248	1.176	1.126	1.099	1.088	1.081	1.073
BBAR =	29.80	20.93	17.73	14.14	44.43	39.70	34.47	26.86	22.07	19.44	17.34	15.35	13.64
BPOS =	3.98	2.25	1.48	1.05	10.60	7.41	4.95	3.41	2.49	1.83	1.40	1.06	.99
THETA =	90.00	92.50	82.50	105.00	22.50	22.50	87.50	92.50	92.50	82.50	82.50	95.00	105.00
BNEG =	-4.06	-1.90	-1.87	-1.10	-11.10	-8.69	-6.16	-3.23	-2.22	-1.68	-1.85	-1.47	-1.07
THETA =	340.00	335.00	332.50	12.50	340.00	340.00	340.00	337.50	337.50	332.50	332.50	332.50	12.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE A-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 2

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 2 WITHOUT PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0381	.0358	.0254	.0197	.0158	.0108	.0052	.0025
PHASE ANGLE =	269.3	267.8	270.2	266.9	263.2	250.6	249.2	180.9
RADIUS = .633								
AMPLITUDE =	.0143	.0262	.0103	.0038	.0055	.0025	.0011	.0016
PHASE ANGLE =	308.9	258.9	262.4	291.4	248.4	284.6	198.6	133.2
RADIUS = .781								
AMPLITUDE =	.0182	.0143	.0093	.0017	.0052	.0016	.0040	.0013
PHASE ANGLE =	286.0	271.3	258.1	233.8	241.3	303.3	218.6	285.4
RADIUS = .963								
AMPLITUDE =	.0195	.0192	.0120	.0061	.0035	.0069	.0070	.0051
PHASE ANGLE =	260.8	245.9	219.3	202.4	204.3	168.5	175.2	155.1

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0058	.0071	.0042	.0083	.0072	.0052	.0030	.0018
PHASE ANGLE =	135.0	129.7	111.1	110.2	107.6	111.3	129.6	15.6
RADIUS = .633								
AMPLITUDE =	.0030	.0012	.0007	.0004	.0022	.0015	.0037	.0035
PHASE ANGLE =	111.9	140.9	84.7	302.5	256.3	231.3	272.7	281.7
RADIUS = .781								
AMPLITUDE =	.0032	.0022	.0041	.0027	.0048	.0024	.0032	.0022
PHASE ANGLE =	85.1	248.3	251.3	279.7	286.7	280.1	281.0	231.7
RADIUS = .963								
AMPLITUDE =	.0022	.0033	.0018	.0023	.0030	.0025	.0007	.0016
PHASE ANGLE =	186.0	133.7	154.6	241.2	242.8	296.2	295.0	125.9

TABLE A-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 2

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 2 WITHOUT PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.0898	.0422	[illegible]	.0445	.0324	.0238	.0153	.0056
PHASE ANGLE =	257.4	283.4	272.3	260.6	266.3	244.7	250.0	237.5
RADIUS = .350								
AMPLITUDE =	.0734	.0404	.0418	.0369	.0273	.0198	.0121	.0043
PHASE ANGLE =	259.4	278.7	271.9	261.8	265.8	245.7	250.1	227.4
RADIUS = .400								
AMPLITUDE =	.0548	.0382	.0334	.0281	.0214	.0152	.0085	.0031
PHASE ANGLE =	263.0	273.2	271.3	263.8	264.8	247.5	250.1	203.2
RADIUS = .500								
AMPLITUDE =	.0281	.0338	.0202	.0143	.0122	.0079	.0033	.0024
PHASE ANGLE =	276.9	264.4	269.0	270.3	261.2	254.4	246.6	161.5
RADIUS = .600								
AMPLITUDE =	.0158	.0284	.0119	.0056	.0066	.0034	.0011	.0021
PHASE ANGLE =	302.3	259.4	264.5	284.1	252.6	273.0	213.5	136.8
RADIUS = .700								
AMPLITUDE =	.0164	.0190	.0097	.0023	.0052	.0025	.0026	.0005
PHASE ANGLE =	297.2	265.9	264.1	281.2	249.6	305.3	224.4	282.8
RADIUS = .800								
AMPLITUDE =	.0185	.0137	.0092	.0019	.0053	.0012	.0043	.0013
PHASE ANGLE =	283.5	271.2	255.3	222.7	237.9	293.4	215.5	278.5
RADIUS = .900								
AMPLITUDE =	.0194	.0147	.0100	.0041	.0066	.0032	.0056	.0020
PHASE ANGLE =	270.2	259.5	234.0	202.2	216.3	174.8	192.4	176.1
RADIUS = 1.000								
AMPLITUDE =	.0195	.0192	.0120	.0061	.0085	.0069	.0070	.0051
PHASE ANGLE =	260.8	248.9	219.3	202.4	204.3	168.5	175.2	155.1

TABLE A-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 2 WITHOUT PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0099	.0148	.0120	.0204	.0193	.0135	.0135	.0085
PHASE ANGLE =	139.0	134.6	127.4	112.2	98.8	98.7	111.1	81.6
RADIUS = .350								
AMPLITUDE =	.0087	.0125	.0103	.0108	.0157	.0110	.0102	.0061
PHASE ANGLE =	138.5	133.4	123.5	111.8	100.3	100.8	112.9	76.0
RADIUS = .400								
AMPLITUDE =	.0072	.0098	.0082	.0125	.0114	.0080	.0064	.0035
PHASE ANGLE =	137.4	131.7	117.9	111.1	102.9	104.5	117.0	61.7
RADIUS = .500								
AMPLITUDE =	.0048	.0053	.0047	.0056	.0044	.0033	.0012	.0020
PHASE ANGLE =	131.8	128.4	105.4	109.1	114.7	121.0	174.2	325.4
RADIUS = .600								
AMPLITUDE =	.0033	.0020	.0017	.0007	.0013	.0013	.0031	.0034
PHASE ANGLE =	118.5	130.7	91.2	99.3	228.4	200.6	268.5	287.7
RADIUS = .700								
AMPLITUDE =	.0033	.0014	.0024	.0018	.0038	.0019	.0036	.0028
PHASE ANGLE =	92.0	239.9	253.4	286.3	282.0	262.8	277.1	259.5
RADIUS = .800								
AMPLITUDE =	.0030	.0021	.0042	.0028	.0048	.0025	.0030	.0021
PHASE ANGLE =	85.7	245.9	250.2	277.9	286.3	282.5	281.9	224.9
RADIUS = .900								
AMPLITUDE =	.0016	.0016	.0027	.0027	.0039	.0027	.0018	.0015
PHASE ANGLE =	120.0	183.4	231.5	262.6	273.3	291.7	286.5	175.5
RADIUS = 1.000								
AMPLITUDE =	.0022	.0033	.0018	.0023	.0030	.0025	.0007	.0016
PHASE ANGLE =	186.0	133.7	154.6	241.2	242.8	296.2	295.0	125.9

TABLE A-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 2

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 2 WITHOUT PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2388	.0053	.0015	.0049	.0035	.0044	.0032	.0033
PHASE ANGLE =	179.5	110.2	135.1	158.9	141.4	144.9	101.5	75.7
RADIUS = .633								
AMPLITUDE =	.2093	.0038	.0043	.0040	.0033	.0030	.0026	.0017
PHASE ANGLE =	181.3	278.1	281.5	262.7	283.4	270.5	286.8	287.8
RADIUS = .781								
AMPLITUDE =	.1950	.0016	.0022	.0019	.0021	.0012	.0016	.0006
PHASE ANGLE =	179.5	153.9	302.9	266.2	273.5	271.6	304.4	249.3
RADIUS = .963								
AMPLITUDE =	.1881	.0083	.0048	.0037	.0028	.0029	.0016	.0017
PHASE ANGLE =	176.6	113.1	113.6	122.1	124.0	107.7	122.9	106.8

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0050	.0052	.0061	.0058	.0059	.0036	.0030	.0010
PHASE ANGLE =	38.5	30.2	26.0	25.2	22.8	22.1	11.0	297.5
RADIUS = .633								
AMPLITUDE =	.0018	.0004	.0038	.0012	.0024	.0030	.0029	.0025
PHASE ANGLE =	313.2	299.6	243.7	186.5	176.9	165.7	175.9	171.9
RADIUS = .781								
AMPLITUDE =	.0011	.0005	.0014	.0017	.0019	.0021	.0010	.0009
PHASE ANGLE =	256.3	263.3	208.3	185.2	197.1	192.4	218.2	224.2
RADIUS = .963								
AMPLITUDE =	.0010	.0011	.0010	.0009	.0013	.0014	.0012	.0007
PHASE ANGLE =	87.1	132.0	114.0	145.1	156.0	157.7	162.6	148.2

TABLE A-6 – HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 2

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 2 WITHOUT PROPELLER
PROPELLER DIAMETER = [illegible].00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2737	.0245	.0124	.0168	.0148	.0163	.0138	.0119
PHASE ANGLE =	176.0	107.9	108.0	129.8	126.9	125.6	101.6	87.2
RADIUS = .350								
AMPLITUDE =	.2635	.0184	.0089	.0129	.0112	.0125	.0105	.0092
PHASE ANGLE =	177.0	108.0	109.6	133.4	128.3	127.8	101.7	85.8
RADIUS = .400								
AMPLITUDE =	.2512	.0115	.0050	.0086	.0072	.0082	.0067	.0061
PHASE ANGLE =	178.3	108.5	113.9	141.0	131.5	132.7	101.7	82.7
RADIUS = .500								
AMPLITUDE =	.2302	.0016	.0011	.0032	.0014	.0024	.0010	.0016
PHASE ANGLE =	180.3	118.9	247.4	188.5	174.0	171.0	99.5	60.2
RADIUS = .600								
AMPLITUDE =	.2137	.0033	.0039	.0037	.0028	.0026	.0021	.0013
PHASE ANGLE =	181.3	278.4	279.1	254.8	279.6	262.3	286.3	297.3
RADIUS = .700								
AMPLITUDE =	.2018	.0019	.0036	.0032	.0030	.0024	.0023	.0012
PHASE ANGLE =	180.5	259.7	291.2	267.8	280.7	272.8	295.8	275.8
RADIUS = .800								
AMPLITUDE =	.1937	.0022	.0018	.0015	.0018	.0009	.0014	.0005
PHASE ANGLE =	179.2	141.8	306.9	262.4	270.0	269.4	306.6	235.4
RADIUS = .900								
AMPLITUDE =	.1891	.0058	.0012	.0015	.0010	.0012	.0003	.0009
PHASE ANGLE =	177.6	122.7	96.7	133.7	153.9	111.0	89.5	125.4
RADIUS = 1.000								
AMPLITUDE =	.1881	.0083	.0036	.0037	.0028	.0029	.0016	.0017
PHASE ANGLE =	176.6	119.1	113.8	122.1	124.0	107.7	122.9	108.8

TABLE A-6 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 2 WITHOUT PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0125	.0133	.0163	.0164	.0192	.0144	.0144	.0080
PHASE ANGLE =	57.0	33.7	30.3	23.7	15.3	4.7	1.5	331.6
RADIUS = .350								
AMPLITUDE =	.0102	.0108	.0132	.0132	.0151	.0110	.0108	.0057
PHASE ANGLE =	53.9	33.2	29.6	23.9	16.3	6.7	2.5	329.9
RADIUS = .400								
AMPLITUDE =	.0075	.0079	.0095	.0094	.0103	.0071	.0067	.0031
PHASE ANGLE =	48.4	32.2	28.3	24.3	18.3	11.0	4.7	324.9
RADIUS = .500								
AMPLITUDE =	.0035	.0034	.0038	.0034	.0030	.0017	.0009	.0009
PHASE ANGLE =	25.9	27.4	22.5	27.1	31.7	51.0	39.3	201.2
RADIUS = .600								
AMPLITUDE =	.0019	.0007	.0005	.0005	.0017	.0025	.0025	.0024
PHASE ANGLE =	332.1	354.0	310.3	164.4	165.7	158.5	172.4	172.2
RADIUS = .700								
AMPLITUDE =	.0014	.0006	.0012	.0016	.0022	.0025	.0017	.0015
PHASE ANGLE =	285.4	283.3	222.1	187.4	189.5	180.5	191.1	191.4
RADIUS = .800								
AMPLITUDE =	.0010	.0004	.0014	.0017	.0016	.0021	.0010	.0008
PHASE ANGLE =	250.0	254.7	204.8	184.2	197.3	193.6	223.2	230.5
RADIUS = .900								
AMPLITUDE =	.0003	.0005	.0010	.0013	.0014	.0015	.0009	.0004
PHASE ANGLE =	166.1	155.6	168.4	172.0	183.6	184.8	213.0	219.6
RADIUS = 1.000								
AMPLITUDE =	.0010	.0011	.0010	.0009	.0013	.0014	.0012	.0007
PHASE ANGLE =	87.1	132.0	114.0	145.1	156.0	157.7	182.6	145.2

TABLE A-7

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 7

INPUT DATA

RADIUS = .456

ANGLE	VX/V	VT/V	VR/V
-1.1	1.002	.013	-.003
8.9	.970	-.010	-.033
18.0	.954	-.132	-.086
28.0	1.101	-.122	-.094
38.9	1.105	-.149	-.089
82.0	1.122	-.249	-.026
126.0	1.114	-.206	.056
179.4	1.109	-.016	.102
223.4	1.119	.144	.077
267.3	1.124	.217	.007
310.0	1.113	.166	-.067
319.2	1.104	.143	-.078
329.1	1.114	.114	-.084
338.0	.989	.111	-.070
349.1	1.013	.041	-.022
358.9	1.002	.013	-.003

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
1.0	1.003	-.020	-.069
45.4	1.042	-.131	-.109
91.2	1.067	-.196	-.006
136.0	1.038	-.129	.096
181.0	1.026	.016	.131
226.0	1.002	.166	.080
269.1	1.047	.220	-.021
270.0	1.047	.220	-.020
280.3	1.053	.215	-.045
304.3	1.040	.181	-.099
317.0	1.036	.155	-.113
338.0	.972	.039	-.120
352.0	.972	.017	-.098
359.3	.966	-.019	-.076
361.0	1.003	-.020	-.069

RADIUS = .781

ANGLE	VX/V	VT/V	VR/V
0.0	.991	-.002	-.097
46.6	1.037	-.133	-.109
90.0	1.052	-.196	.011
136.9	1.042	-.132	.127
179.3	1.043	-.005	.175
225.3	1.052	.127	.132
269.0	1.073	.185	.027
314.9	1.051	.139	-.092
360.0	.991	-.002	-.097

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
-1.0	1.006	.046	-.137
19.0	.961	-.053	-.144
39.3	1.026	-.108	-.160
59.3	1.041	-.151	-.112
91.1	1.053	-.184	-.017
135.1	1.048	-.128	.107
180.0	1.052	.003	.159
224.8	1.054	.125	.113
270.7	1.063	.184	-.003
291.1	1.057	.178	-.057
310.0	1.056	.150	-.109
331.1	1.025	.154	-.149
351.2	1.030	.074	-.159
356.8	1.007	.053	-.150
359.0	.991	.049	-.140
359.0	1.006	.046	-.137

TABLE A-8 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND THE INTERPOLATED RADII FOR EXPERIMENT 7

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 7
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	1.098	1.029	1.044	1.042	1.223	1.184	1.139	1.072	1.035	1.038	1.045	1.045	1.042
VTBAR =	-.011	.009	-.002	.009	-.054	-.041	-.025	-.003	.008	.002	-.002	.002	.009
VRBAR =	.005	-.006	.018	-.007	.045	.032	.017	-.001	-.007	.010	.018	.008	-.007
1-WVX =	1.149	1.091	1.067	1.058	0.000	1.203	1.178	1.134	1.099	1.077	1.067	1.062	1.058
1-WX =	1.190	1.107	1.077	1.065	0.000	1.268	1.227	1.163	1.118	1.090	1.077	1.070	1.064
BBAR =	29.66	20.86	17.45	14.24	43.87	39.28	34.21	26.79	22.02	19.20	17.08	15.26	13.74
BPOS =	3.94	2.29	1.14	.82	6.76	5.76	4.75	3.45	2.55	1.64	1.07	.84	.77
THETA =	87.50	90.00	90.00	92.50	82.50	82.50	82.50	90.00	90.00	90.00	90.00	92.50	92.50
BNEG =	-3.89	-1.55	-.84	-1.02	-10.86	-8.14	-5.63	-2.91	-1.67	-1.13	-.86	-.86	-.99
THETA =	340.00	227.50	0.00	10.00	7.50	7.50	340.00	340.00	230.00	357.50	0.00	5.00	10.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAP IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE A-9 – HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 7

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 7
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0343	.0361	.0230	.0164	.0103	.0057	.0036	.0061
PHASE ANGLE =	265.6	270.9	266.1	266.0	260.7	240.1	172.8	127.4
RADIUS = .633								
AMPLITUDE =	.0154	.0261	.0151	.0061	.0053	.0043	.0031	.0024
PHASE ANGLE =	337.8	262.5	298.6	7.3	328.0	352.1	12.8	24.5
RADIUS = .781								
AMPLITUDE =	.0152	.0191	.0075	.0022	.0026	.0018	.0011	.0009
PHASE ANGLE =	230.4	267.0	276.0	271.1	266.2	272.4	272.2	268.8
RADIUS = .963								
AMPLITUDE =	.0224	.0192	.0113	.0078	.0068	.0063	.0061	.0049
PHASE ANGLE =	246.8	248.7	227.9	196.1	187.0	164.3	152.4	152.5

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0089	.0100	.0096	.0077	.0050	.0019	.0010	.0029
PHASE ANGLE =	114.6	110.4	109.5	110.1	111.9	121.6	263.3	282.8
RADIUS = .633								
AMPLITUDE =	.0016	.0004	.0008	.0010	.0015	.0015	.0014	.0014
PHASE ANGLE =	41.1	45.4	295.2	326.1	321.1	337.3	346.6	350.1
RADIUS = .781								
AMPLITUDE =	.0007	.0006	.0005	.0003	.0004	.0003	.0002	.0002
PHASE ANGLE =	270.0	269.1	272.6	270.7	266.5	272.6	272.0	267.3
RADIUS = .963								
AMPLITUDE =	.0032	.0016	.0007	.0004	.0003	.0004	.0005	.0006
PHASE ANGLE =	156.6	170.2	196.5	200.6	201.4	159.1	134.0	124.5

TABLE A-10 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 7

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 7
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.1008	.0470	.0396	.0503	.0272	.0227	.0172	.0180
PHASE ANGLE =	238.3	281.4	236.3	248.4	233.5	215.5	185.4	149.0
RADIUS = .350								
AMPLITUDE =	.0787	.0437	.0338	.0395	.0216	.0172	.0129	.0142
PHASE ANGLE =	242.3	278.5	242.9	250.9	237.8	218.2	184.0	145.7
RADIUS = .400								
AMPLITUDE =	.0544	.0399	.0278	.0272	.0154	.0110	.0080	.0099
PHASE ANGLE =	250.3	274.8	253.1	255.8	245.9	224.2	181.1	139.5
RADIUS = .500								
AMPLITUDE =	.0244	.0334	.0204	.0102	.0077	.0033	.0012	.0040
PHASE ANGLE =	284.8	268.0	276.5	281.9	277.9	272.6	139.8	110.1
RADIUS = .600								
AMPLITUDE =	.0170	.0278	.0164	.0059	.0056	.0041	.0028	.0024
PHASE ANGLE =	331.2	263.3	295.1	353.1	320.2	346.7	17.5	41.3
RADIUS = .700								
AMPLITUDE =	.0084	.0222	.0108	.0034	.0038	.0029	.0019	.0014
PHASE ANGLE =	274.8	266.1	293.7	345.0	310.9	327.6	340.8	345.5
RADIUS = .800								
AMPLITUDE =	.0168	.0187	.0071	.0025	.0026	.0017	.0011	.0009
PHASE ANGLE =	228.3	266.4	269.4	252.7	251.7	252.6	245.5	245.2
RADIUS = .900								
AMPLITUDE =	.0216	.0178	.0084	.0055	.0047	.0038	.0034	.0027
PHASE ANGLE =	233.2	257.7	236.6	208.4	200.3	181.6	167.6	169.5
RADIUS = 1.000								
AMPLITUDE =	.0224	.0192	.0113	.0078	.0068	.0063	.0061	.0049
PHASE ANGLE =	246.8	248.7	227.9	196.1	187.0	164.3	152.4	152.5

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ANALYSIS OF WAKE SURVEY EXPERIMENTAL DATA FOR MODEL 5365 REPRES--ETC(U)
OCT 80 R B HURWITZ, L B CROOK

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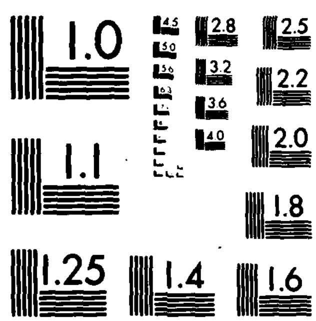

MICROCOPY RESOLUTION TEST CHART

TABLE A-10 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 7
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0219	.0252	.0266	.0222	.0163	.0082	.0043	.0073
PHASE ANGLE =	125.7	112.8	110.2	114.4	119.0	138.7	209.6	256.0
RADIUS = .350								
AMPLITUDE =	.0179	.0206	.0214	.0177	.0128	.0062	.0031	.0059
PHASE ANGLE =	123.8	112.4	110.1	113.7	118.0	136.9	214.9	260.5
RADIUS = .400								
AMPLITUDE =	.0132	.0152	.0153	.0126	.0087	.0039	.0019	.0043
PHASE ANGLE =	120.3	111.7	109.9	112.5	116.1	132.7	227.9	268.8
RADIUS = .500								
AMPLITUDE =	.0061	.0067	.0059	.0047	.0027	.0008	.0010	.0022
PHASE ANGLE =	107.4	108.8	109.0	106.5	104.3	89.2	304.7	298.6
RADIUS = .600								
AMPLITUDE =	.0021	.0013	.0003	.0006	.0010	.0013	.0014	.0015
PHASE ANGLE =	67.1	94.7	91.8	20.7	337.1	343.5	343.1	340.1
RADIUS = .700								
AMPLITUDE =	.0008	.0004	.0007	.0006	.0008	.0008	.0007	.0007
PHASE ANGLE =	354.2	307.2	289.7	312.8	308.5	323.6	332.2	334.2
RADIUS = .800								
AMPLITUDE =	.0007	.0007	.0005	.0003	.0004	.0003	.0002	.0002
PHASE ANGLE =	250.3	260.3	265.9	256.2	251.4	252.2	245.2	239.6
RADIUS = .900								
AMPLITUDE =	.0018	.0009	.0005	.0003	.0004	.0004	.0004	.0004
PHASE ANGLE =	176.3	197.9	218.4	208.8	204.4	186.9	167.7	160.5
RADIUS = 1.000								
AMPLITUDE =	.0032	.0016	.0007	.0004	.0003	.0004	.0005	.0006
PHASE ANGLE =	156.6	170.2	196.5	200.6	201.4	159.1	134.0	124.5

TABLE A-11 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 7

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 7
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2328	.0054	.0027	.0050	.0052	.0045	.0036	.0031
PHASE ANGLE =	178.2	98.9	162.2	165.5	154.3	135.9	102.0	75.4
RADIUS = .633								
AMPLITUDE =	.2045	.0092	.0065	.0051	.0026	.0024	.0022	.0017
PHASE ANGLE =	182.8	300.5	308.9	303.2	347.4	29.1	55.7	106.5
RADIUS = .781								
AMPLITUDE =	.1885	.0030	.0020	.0016	.0011	.0004	.0005	.0004
PHASE ANGLE =	178.5	123.4	279.6	245.4	224.6	222.7	297.8	254.8
RADIUS = .963								
AMPLITUDE =	.1869	.0133	.0074	.0072	.0055	.0032	.0017	.0012
PHASE ANGLE =	175.3	130.4	162.0	173.1	191.1	212.6	265.8	329.3

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0032	.0043	.0051	.0054	.0052	.0047	.0040	.0031
PHASE ANGLE =	53.9	39.2	29.3	21.8	16.3	11.9	8.7	2.8
RADIUS = .633								
AMPLITUDE =	.0019	.0016	.0015	.0015	.0012	.0009	.0008	.0006
PHASE ANGLE =	143.4	170.1	201.2	228.5	247.5	268.4	288.1	290.0
RADIUS = .781								
AMPLITUDE =	.0003	.0001	.0002	.0002	.0001	.0001	.0001	.0001
PHASE ANGLE =	226.4	272.3	284.3	261.2	240.3	243.1	299.6	259.4
RADIUS = .963								
AMPLITUDE =	.0013	.0015	.0012	.0008	.0006	.0004	.0002	.0002
PHASE ANGLE =	27.0	56.9	81.5	107.7	128.2	132.3	126.1	127.2

TABLE A-12 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 7

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 7
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2678	.0401	.0216	.0241	.0207	.0149	.0064	.0046
PHASE ANGLE =	169.4	113.3	141.9	148.0	161.4	160.7	139.9	45.5
RADIUS = .350								
AMPLITUDE =	.2570	.0289	.0155	.0180	.0158	.0115	.0054	.0041
PHASE ANGLE =	172.0	112.3	143.0	149.6	160.5	157.4	131.6	53.2
RADIUS = .400								
AMPLITUDE =	.2446	.0163	.0087	.0111	.0102	.0077	.0043	.0036
PHASE ANGLE =	175.2	109.9	146.1	153.3	158.7	150.6	118.6	63.7
RADIUS = .500								
AMPLITUDE =	.2246	.0020	.0016	.0020	.0022	.0028	.0032	.0028
PHASE ANGLE =	180.2	342.2	277.0	209.6	143.4	112.4	88.7	84.0
RADIUS = .600								
AMPLITUDE =	.2090	.0090	.0060	.0046	.0022	.0023	.0025	.0020
PHASE ANGLE =	182.7	301.9	308.4	300.5	353.1	40.5	62.9	101.2
RADIUS = .700								
AMPLITUDE =	.1956	.0033	.0045	.0032	.0013	.0011	.0010	.0007
PHASE ANGLE =	180.8	302.3	305.5	296.0	328.3	26.5	44.0	124.7
RADIUS = .800								
AMPLITUDE =	.1874	.0043	.0016	.0017	.0015	.0007	.0006	.0005
PHASE ANGLE =	178.1	124.1	259.2	223.7	213.0	217.7	282.4	268.3
RADIUS = .900								
AMPLITUDE =	.1853	.0103	.0042	.0046	.0039	.0023	.0015	.0010
PHASE ANGLE =	176.1	127.7	169.6	177.8	194.4	213.2	265.4	304.7
RADIUS = 1.000								
AMPLITUDE =	.1869	.0133	.0074	.0072	.0055	.0032	.0017	.0012
PHASE ANGLE =	175.3	130.4	162.0	173.1	191.1	212.6	265.8	329.3

TABLE A-12 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 7
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0094	.0142	.0171	.0174	.0156	.0129	.0103	.0079
PHASE ANGLE =	21.9	25.9	27.0	27.0	24.5	21.7	18.9	12.6
RADIUS = .350								
AMPLITUDE =	.0073	.0111	.0133	.0136	.0123	.0104	.0084	.0064
PHASE ANGLE =	26.6	27.7	27.3	26.3	23.3	20.2	17.2	11.0
RADIUS = .400								
AMPLITUDE =	.0050	.0075	.0090	.0093	.0086	.0074	.0061	.0047
PHASE ANGLE =	35.8	31.3	27.9	24.9	21.0	17.3	14.2	8.0
RADIUS = .500								
AMPLITUDE =	.0023	.0023	.0026	.0029	.0031	.0030	.0027	.0021
PHASE ANGLE =	77.1	53.8	31.9	16.0	8.6	4.1	1.4	356.1
RADIUS = .600								
AMPLITUDE =	.0020	.0014	.0010	.0010	.0009	.0009	.0009	.0007
PHASE ANGLE =	132.7	155.5	195.7	242.7	275.6	299.9	314.8	315.4
RADIUS = .700								
AMPLITUDE =	.0010	.0008	.0007	.0008	.0006	.0005	.0004	.0003
PHASE ANGLE =	163.2	186.1	216.7	237.7	250.4	269.0	291.0	285.6
RADIUS = .800								
AMPLITUDE =	.0003	.0002	.0002	.0001	.0001	.0000	.0001	.0001
PHASE ANGLE =	254.6	330.9	333.9	290.4	211.9	168.2	308.7	232.8
RADIUS = .900								
AMPLITUDE =	.0007	.0009	.0007	.0005	.0004	.0003	.0002	.0002
PHASE ANGLE =	358.9	38.7	60.8	90.2	117.0	121.4	116.6	133.1
RADIUS = 1.000								
AMPLITUDE =	.0013	.0015	.0012	.0008	.0006	.0004	.0002	.0002
PHASE ANGLE =	27.0	56.9	81.5	107.7	128.2	132.3	126.1	127.2

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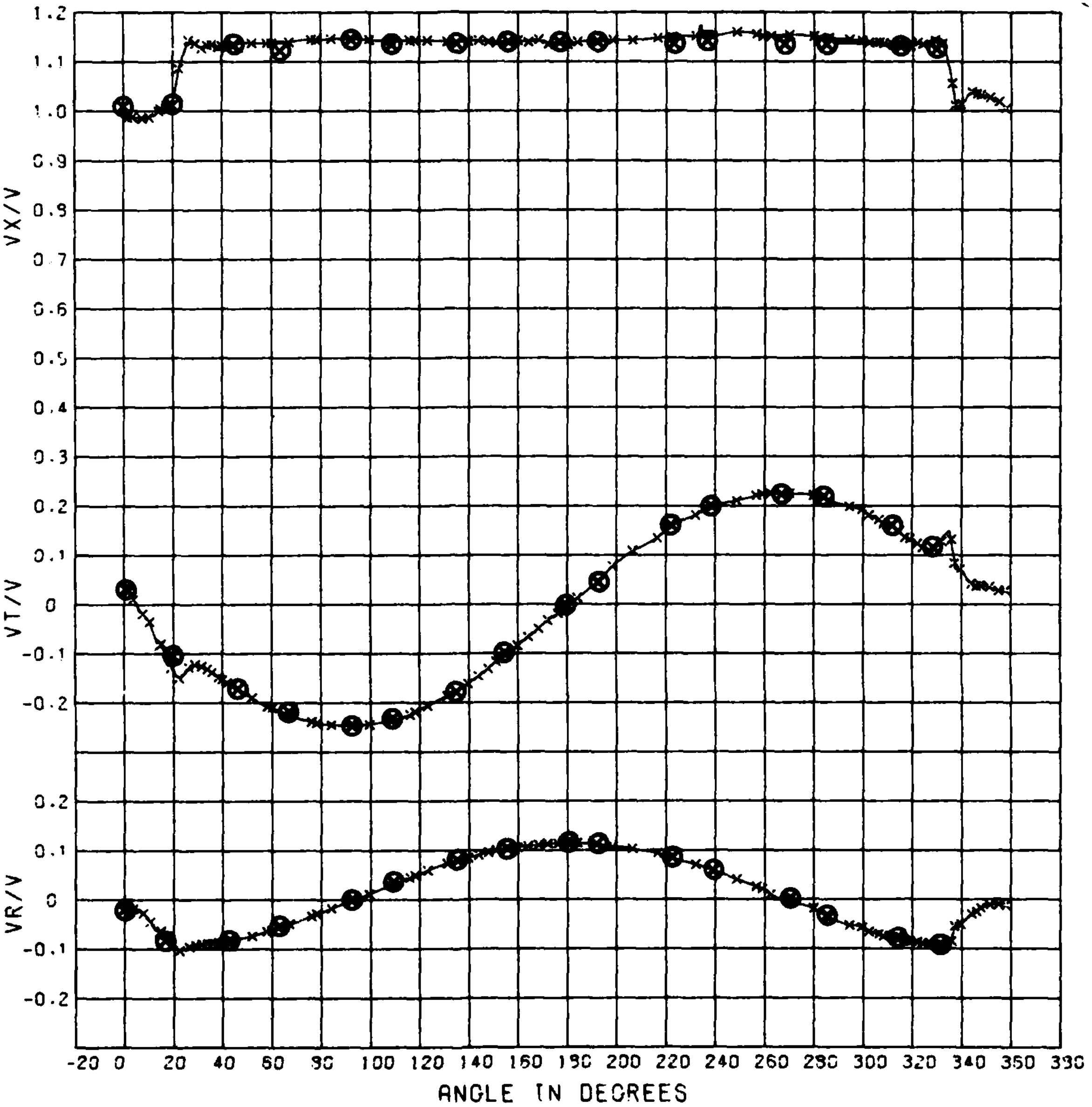
APPENDIX B

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

FOR EXPERIMENTS 3 AND 9



VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3

0.456 RAD.

Figure B-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiments 3 and 9

x : Experiment 3
⊗ : Experiment 9

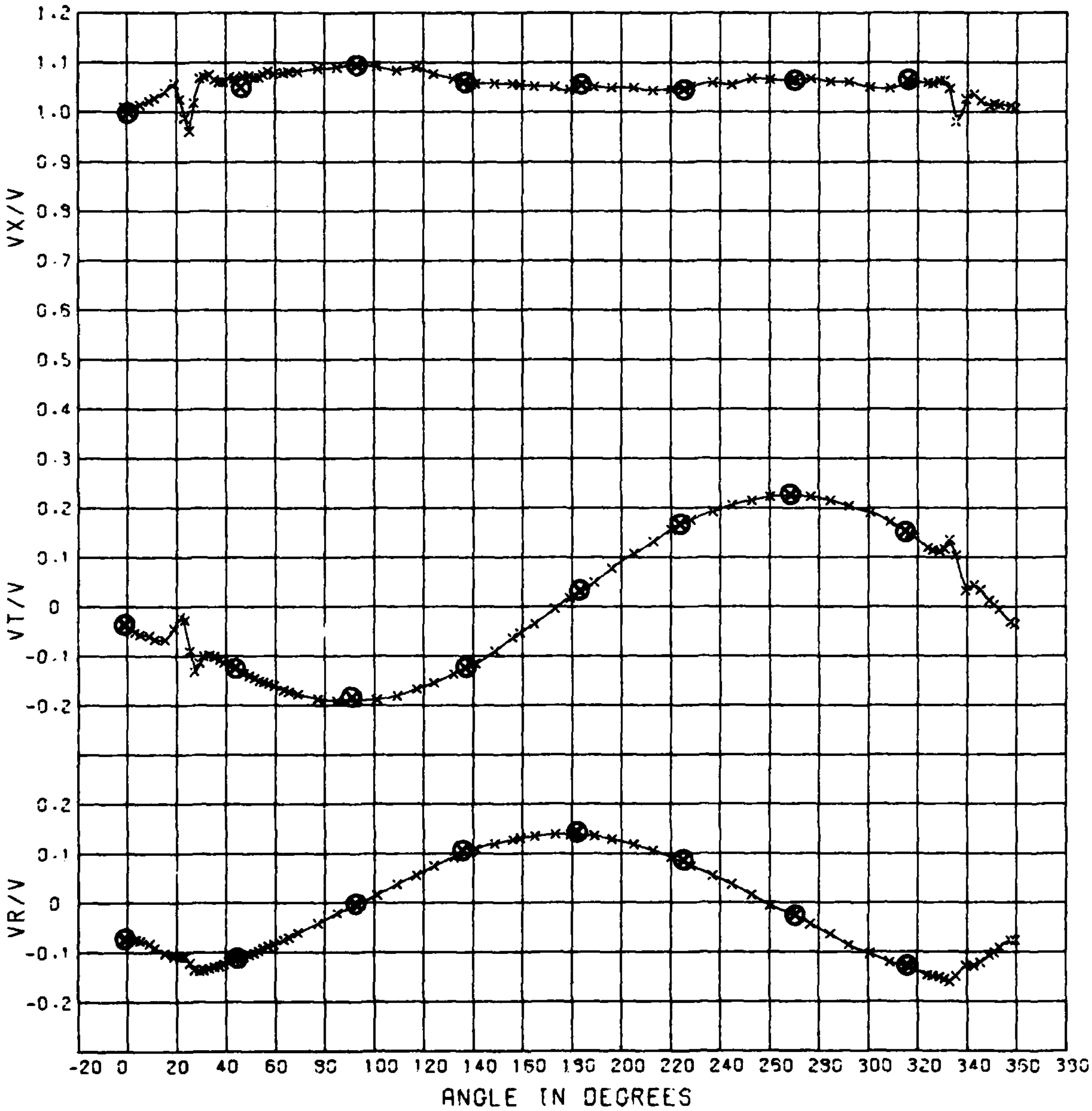
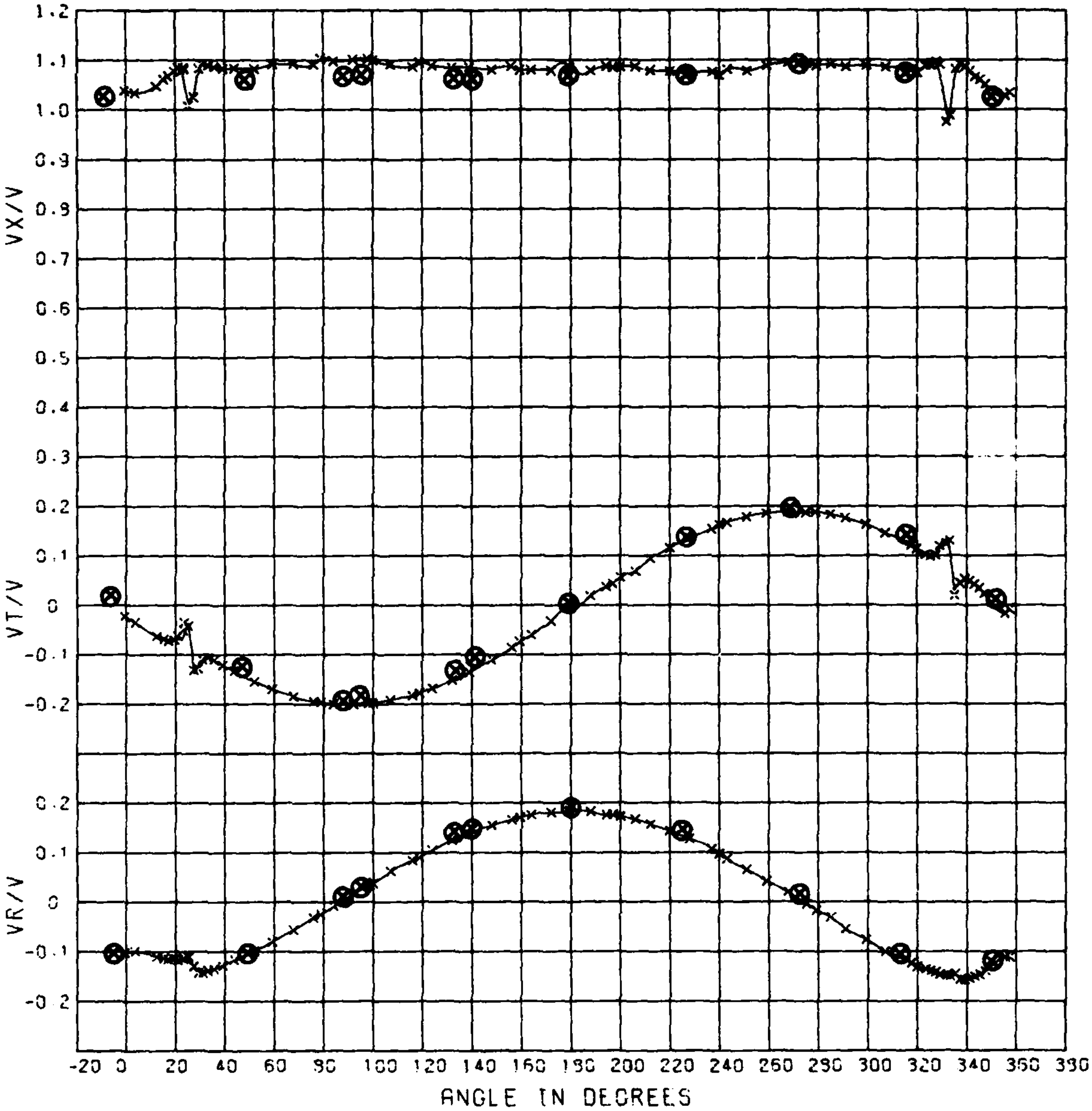


Figure B-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiments 3 and 9

x : Experiment 3
⊗ : Experiment 9



VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3

0.781 RAD.

Figure B-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiments 3 and 9

x : Experiment 3
⊗ : Experiment 9

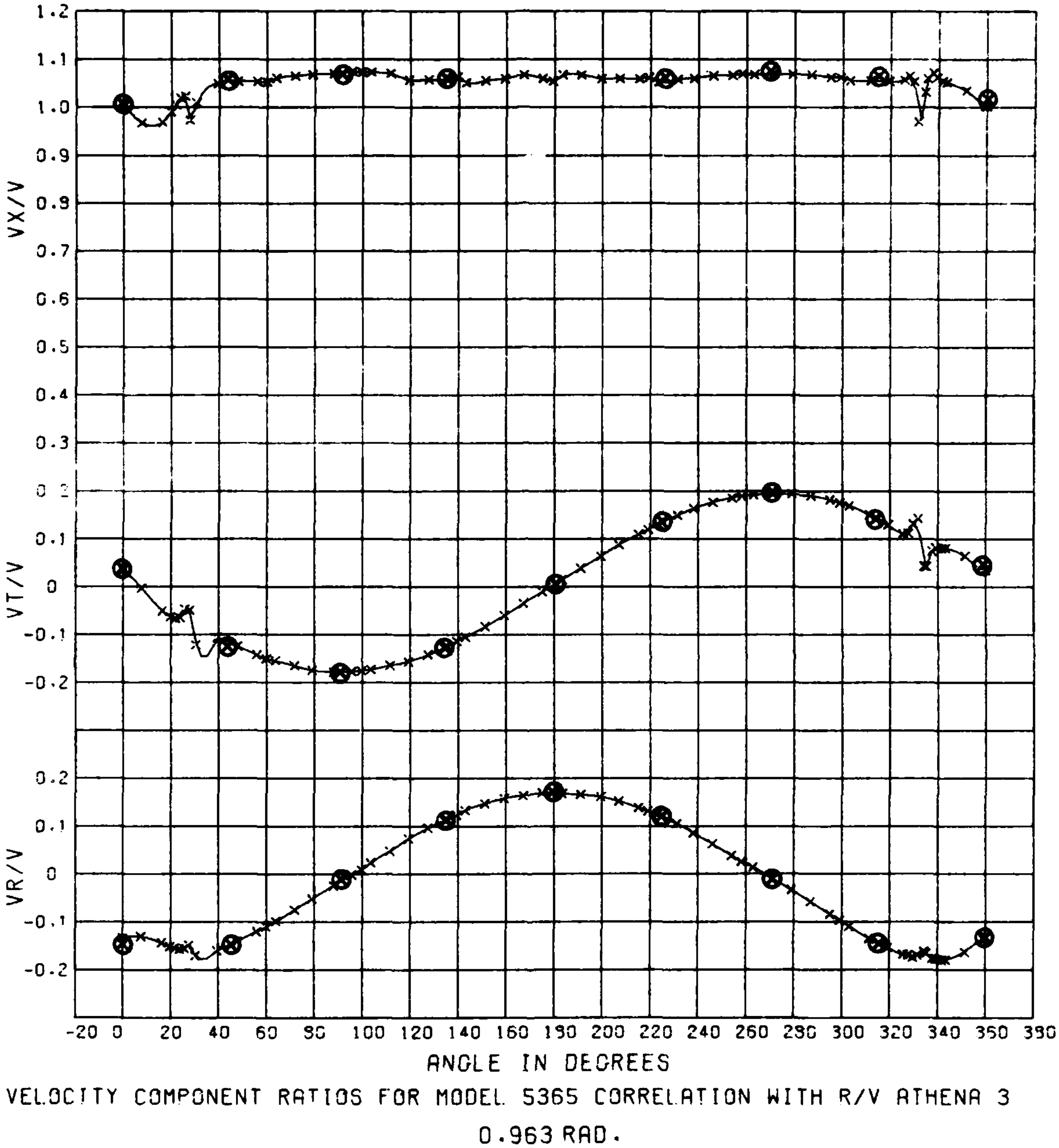


Figure B-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiments 3 and 9

x : Experiment 3
⊗ : Experiment 9

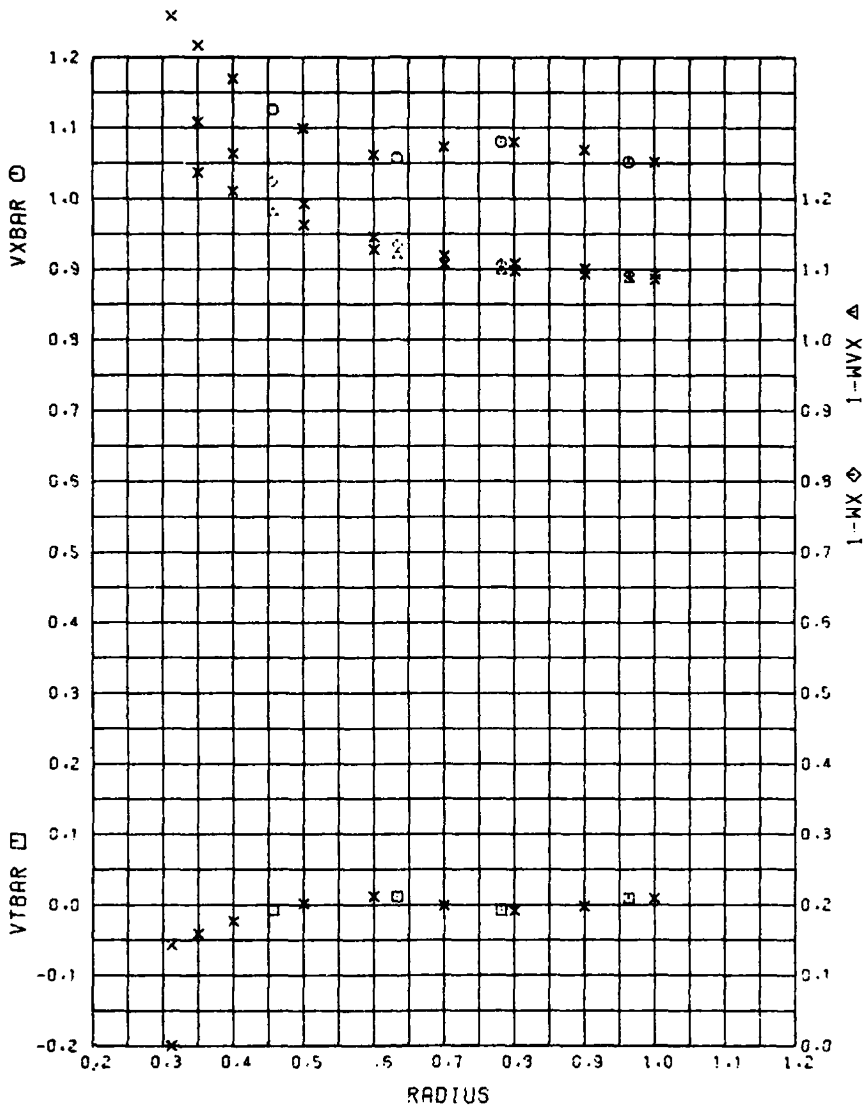


Figure B-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 3

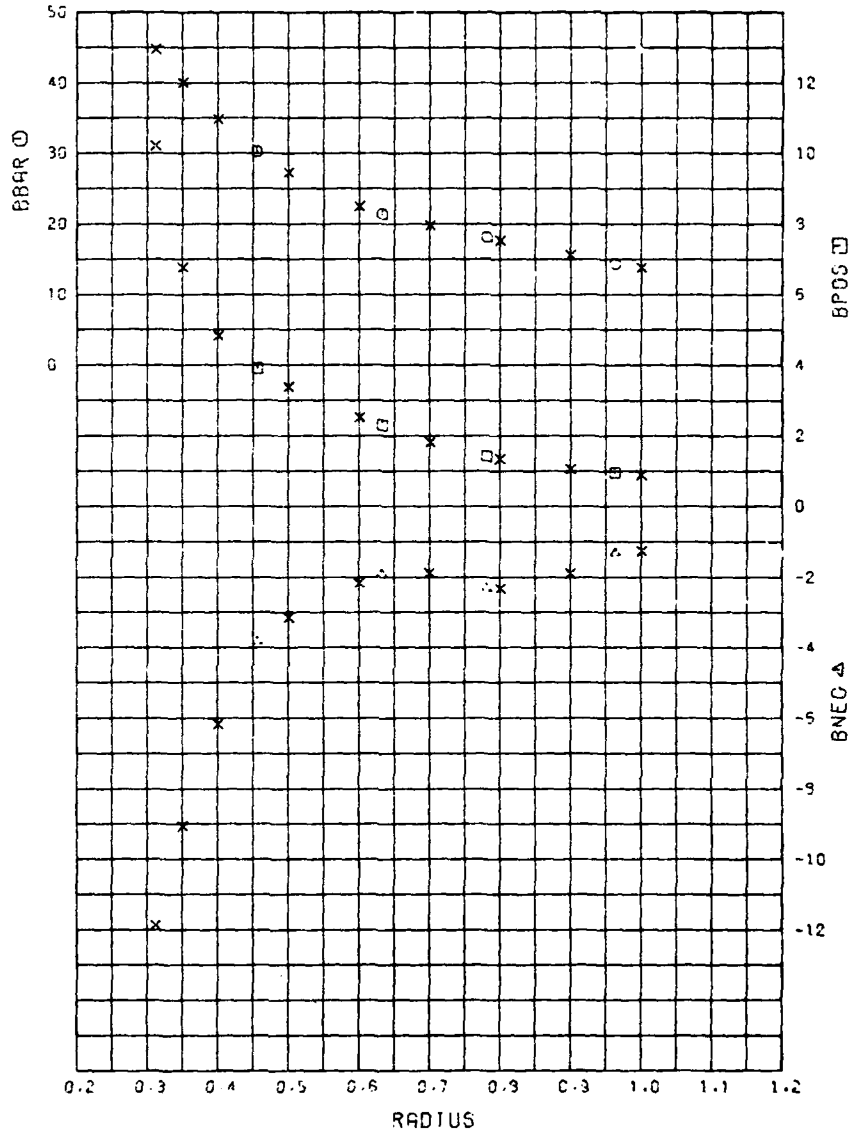


Figure B-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 3

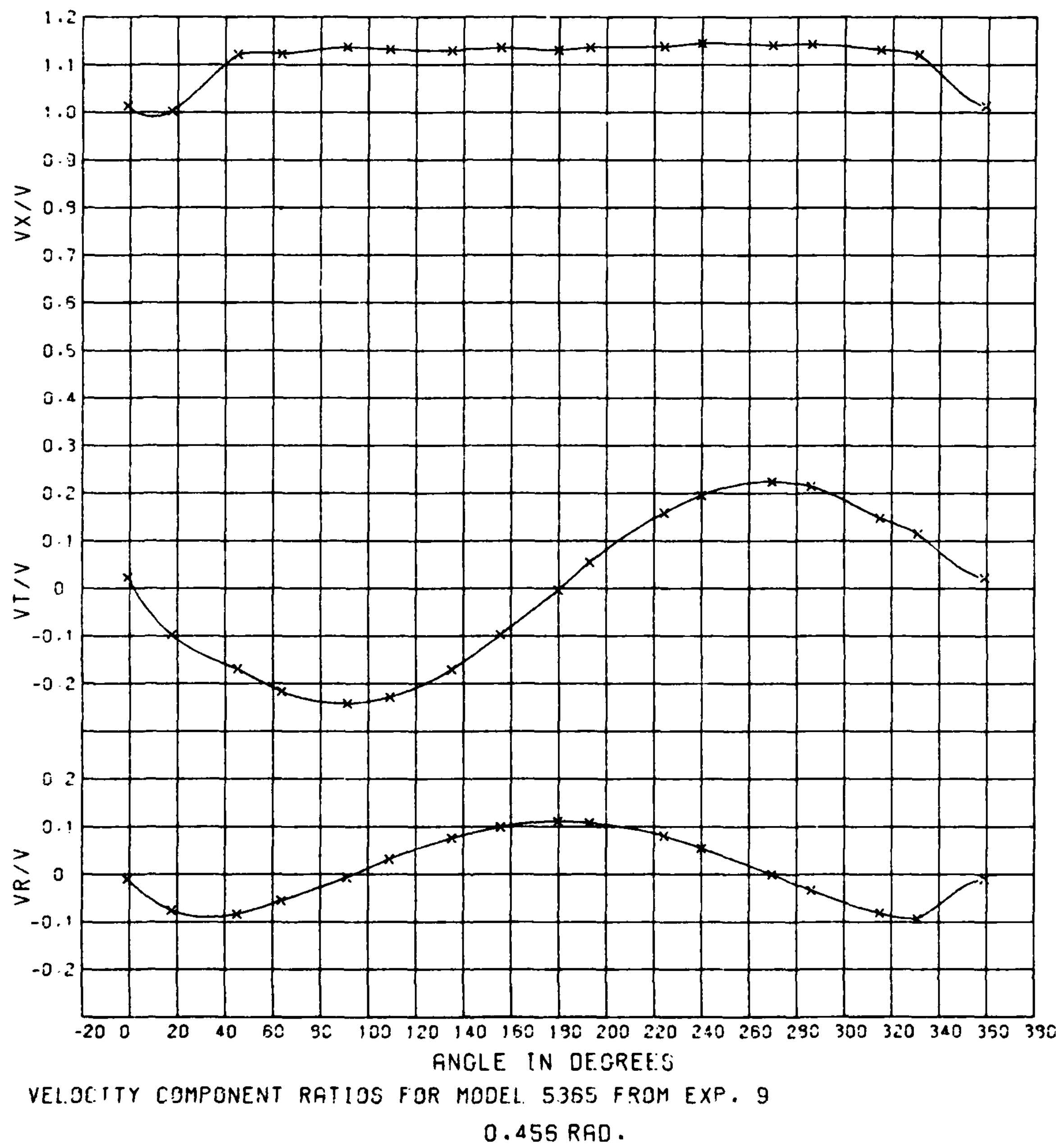


Figure B-7 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 9

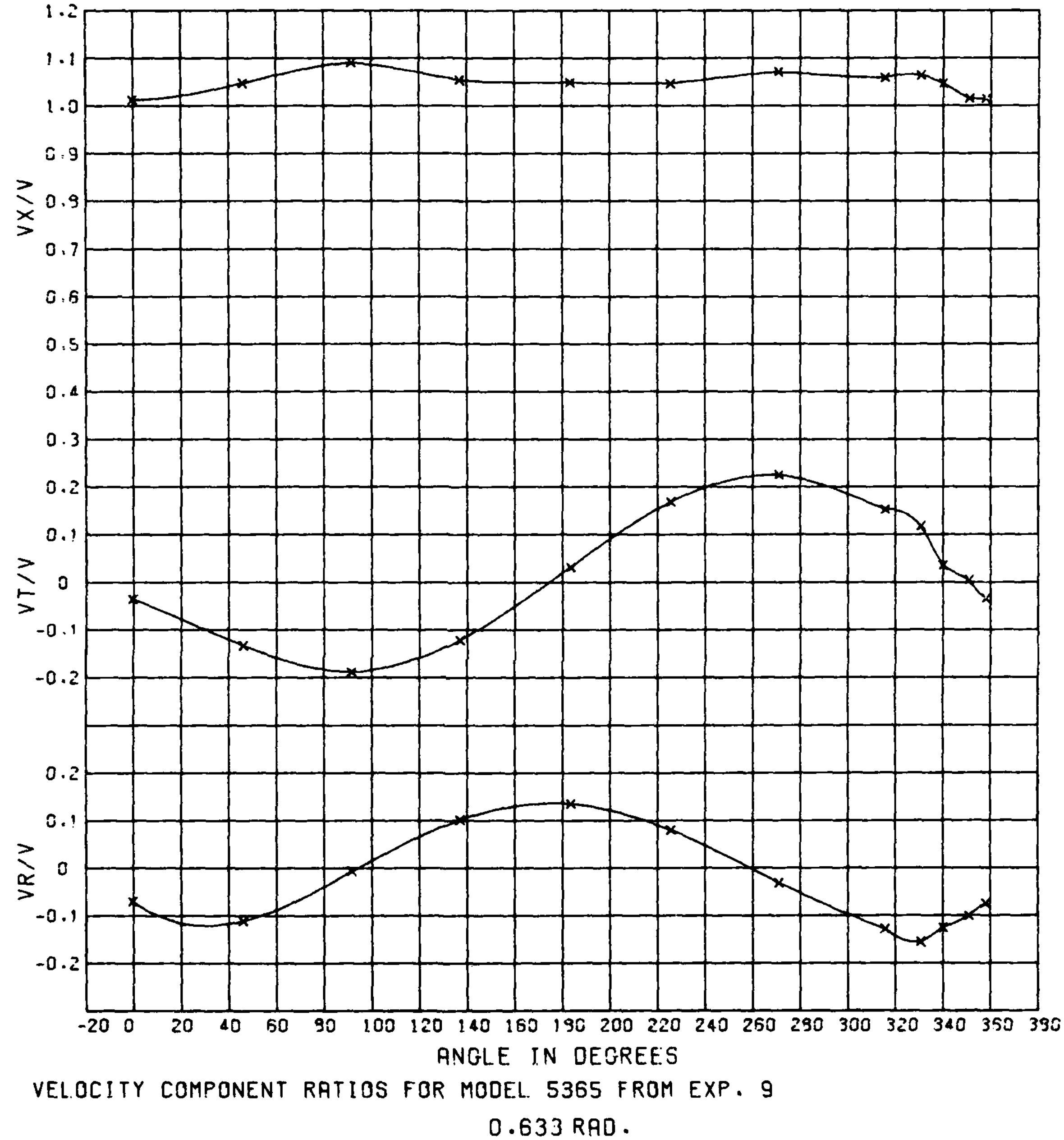


Figure B-8 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 9

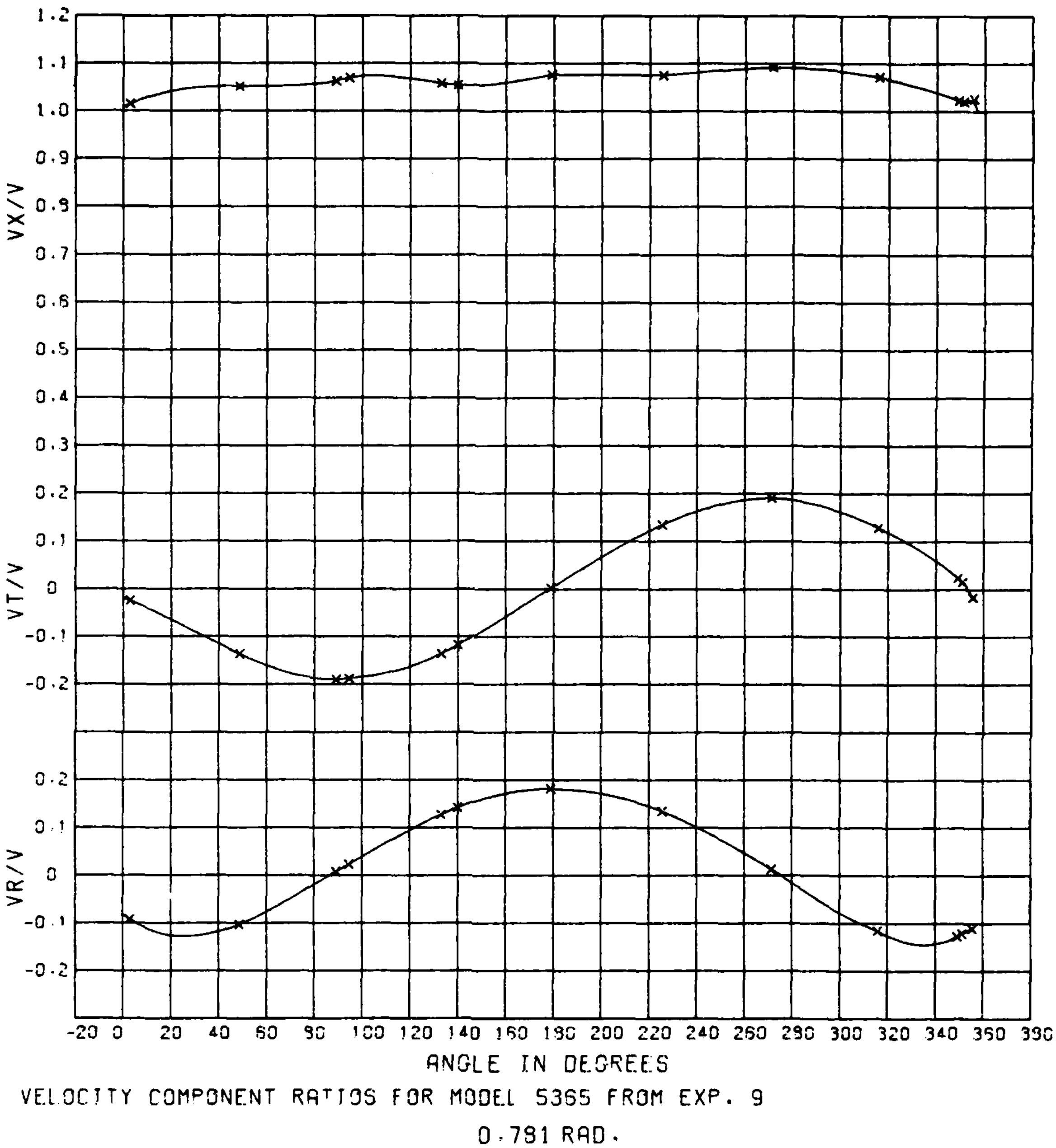


Figure B-9 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 9

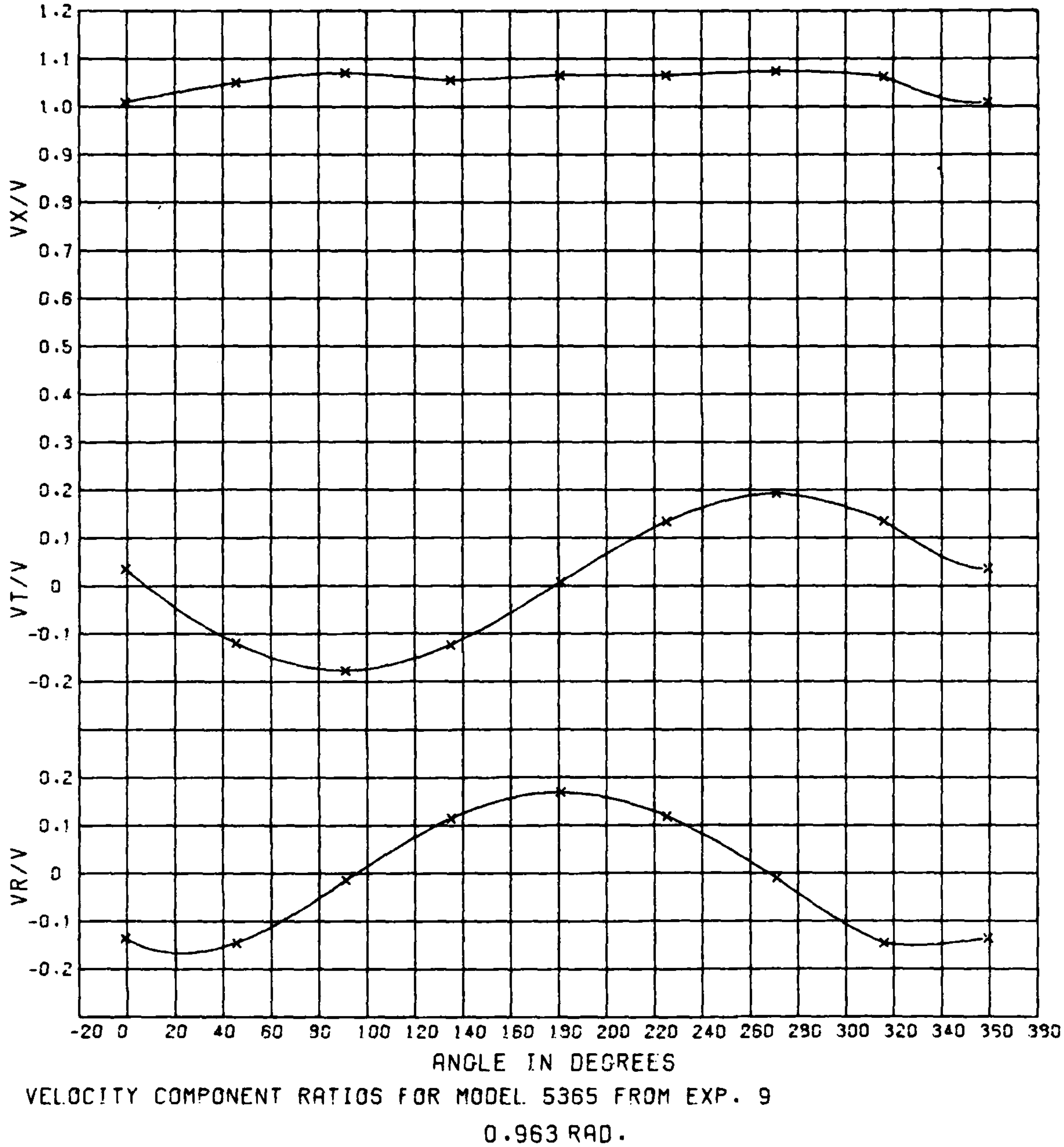


Figure B-10 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 9

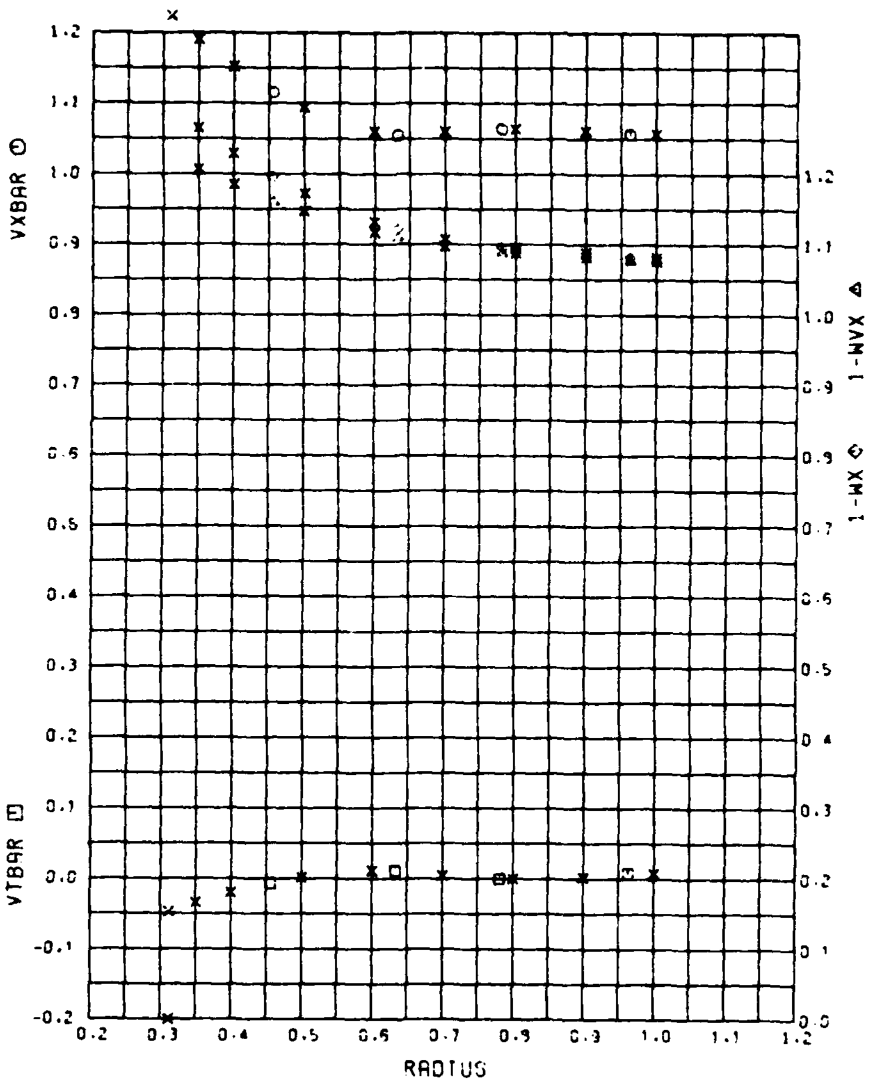


Figure B-11 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 9

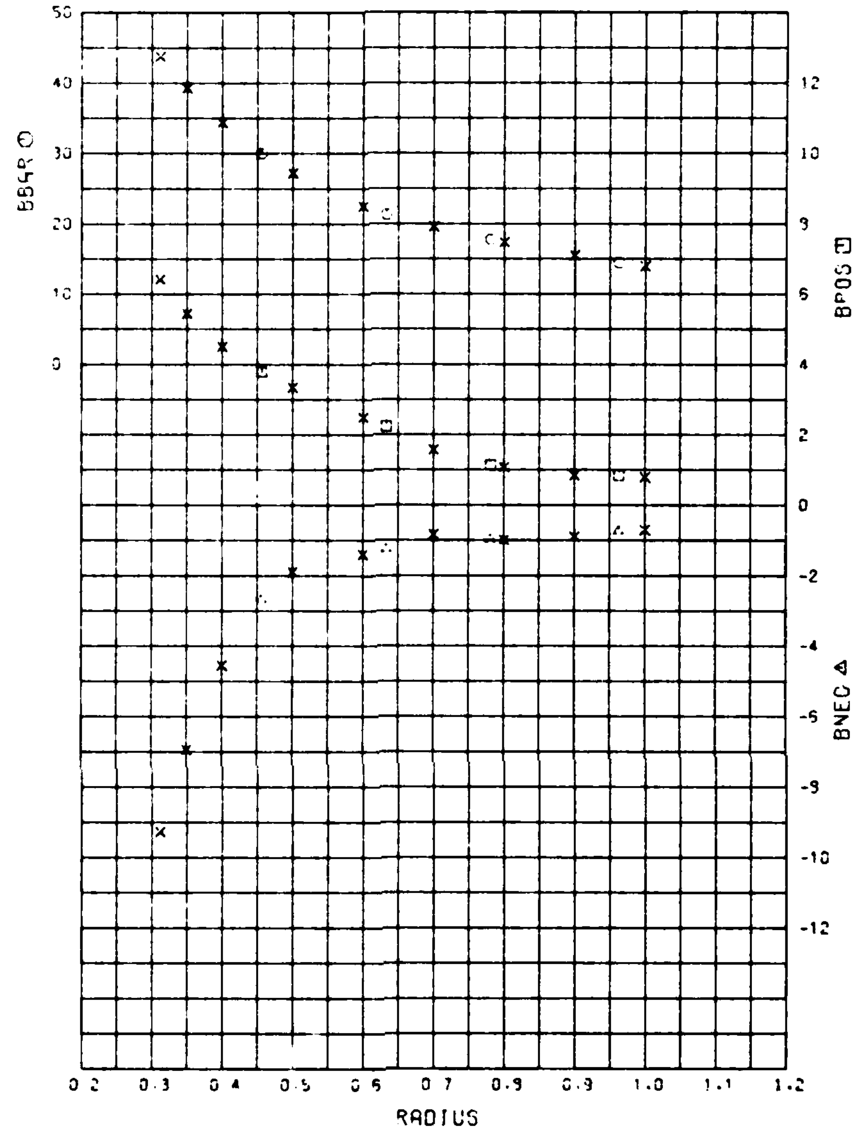


Figure B-12 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 9

TABLE B-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 3

RADIUS = .456

ANGLE	VX/V	VT/V	VR/V
1.7	.987	.027	-.017
3.6	.998	.017	-.016
3.6	.986	.003	-.021
7.6	.986	-.019	-.027
9.7	.993	-.027	-.040
11.0	.991	-.042	-.069
13.6	.998	-.065	-.055
15.0	1.002	-.102	-.076
15.0	1.006	-.090	-.063
17.5	1.006	-.097	-.074
19.0	1.000	-.176	-.091
19.0	1.017	-.132	-.093
21.7	1.058	-.150	-.102
23.0	1.114	-.150	-.106
24.7	1.146	-.132	-.097
27.0	1.141	-.123	-.096
29.0	1.137	-.122	-.092
31.5	1.127	-.126	-.091
33.0	1.136	-.131	-.090
35.7	1.135	-.130	-.089
37.7	1.137	-.145	-.088
39.0	1.127	-.152	-.088
39.0	1.132	-.152	-.087
41.6	1.128	-.159	-.086
43.0	1.136	-.166	-.083
51.9	1.138	-.190	-.076
56.0	1.138	-.208	-.065
59.9	1.138	-.218	-.062
67.0	1.141	-.227	-.049
75.9	1.145	-.238	-.033
78.0	1.146	-.241	-.029
83.9	1.147	-.245	-.017
91.9	1.148	-.247	-.002
99.0	1.148	-.245	.010
99.0	1.142	-.246	.013
107.9	1.146	-.237	.030
115.9	1.143	-.276	.045
118.0	1.146	-.218	.049
123.0	1.146	-.206	.060
131.0	1.148	-.186	.074
139.2	1.141	-.166	.086
139.9	1.142	-.160	.086
143.9	1.143	-.146	.098
147.0	1.140	-.131	.096
151.0	1.139	-.116	.100
155.7	1.140	-.100	.106
159.6	1.143	-.085	.106
163.9	1.140	-.046	.109
168.2	1.149	-.090	.111
171.9	1.136	-.077	.113
175.7	1.134	-.016	.115
180.1	1.131	-.006	.115
184.0	1.140	.012	.115
192.0	1.141	.045	.113
196.6	1.146	.074	.109
200.6	1.143	.100	.103
210.1	1.143	.135	.096
220.5	1.149	.160	.085
232.0	1.153	.181	.071
238.9	1.151	.199	.058
244.0	1.151	.210	.042
250.6	1.156	.220	.026
259.0	1.151	.226	.021
262.9	1.152	.225	.010
268.9	1.149	.226	.005
270.6	1.147	.223	-.017
279.6	1.156	.219	-.021
286.0	1.149	.211	-.037
290.3	1.145	.198	-.052
299.6	1.142	.190	-.056
302.3	1.139	.181	-.065
303.1	1.141	.179	-.069
306.7	1.136	.169	-.072
308.2	1.138	.166	-.075
309.9	1.134	.159	-.077
311.1	1.143	.158	-.079
315.1	1.135	.145	-.082
317.0	1.136	.138	-.086
317.0	1.134	.132	-.089
319.0	1.131	.133	-.095
322.1	1.140	.126	-.097
324.0	1.133	.119	-.098
326.0	1.139	.113	-.088
327.0	1.136	.108	-.089
329.0	1.140	.113	-.097
331.0	1.136	.120	-.092
333.0	1.088	.126	-.077
335.0	1.025	.124	-.077
337.0	1.011	.083	-.059
339.0	1.008	.090	-.063
340.2	1.026	.052	-.036
343.9	1.039	.042	-.029
345.9	1.034	.037	-.025
347.7	1.029	.030	-.015
351.0	1.023	.030	-.010
353.7	1.038	.036	-.010
355.0	1.018	.028	-.010
357.0	1.009	.030	-.011
359.0	.998	.030	-.013

RADIUS = .631

ANGLE	VX/V	VT/V	VR/V
-7.0	1.014	-.035	-.076
-.7	1.007	-.016	-.076
-.7	1.007	-.037	-.076
3.3	1.009	-.052	-.075
5.2	1.016	-.056	-.077
9.0	1.021	-.059	-.083
11.2	1.027	-.067	-.092
15.3	1.039	-.068	-.103
19.0	1.056	-.066	-.108
19.0	1.068	-.066	-.108
21.6	1.026	-.021	-.100
23.3	.988	-.027	-.109
25.3	.961	-.091	-.122
27.0	1.018	-.131	-.135
29.3	1.060	-.116	-.130
31.0	1.071	-.100	-.136
33.2	1.075	-.098	-.132
35.1	1.065	-.101	-.129
37.3	1.061	-.108	-.128
39.0	1.059	-.116	-.123
39.0	1.063	-.116	-.126
41.3	1.071	-.110	-.119
43.3	1.064	-.126	-.115
47.0	1.072	-.139	-.109
49.3	1.073	-.140	-.105
51.6	1.069	-.145	-.102
53.3	1.078	-.151	-.098
55.0	1.076	-.153	-.093
57.0	1.082	-.157	-.088
59.0	1.078	-.161	-.086
59.5	1.075	-.161	-.086
63.3	1.079	-.169	-.075
65.3	1.081	-.173	-.070
69.0	1.081	-.170	-.061
77.2	1.087	-.107	-.061
85.0	1.089	-.141	-.021
93.2	1.094	-.198	-.004
101.0	1.091	-.148	.016
109.1	1.086	-.181	.030
117.0	1.089	-.167	.056
124.0	1.077	-.156	.075
132.0	1.060	-.136	.092
135.1	1.059	-.118	.103
139.2	1.055	-.110	.105
140.9	1.050	-.115	.109
149.0	1.058	-.098	.120
156.0	1.057	-.063	.120
159.0	1.055	-.053	.131
164.0	1.052	-.036	.135
173.0	1.052	-.006	.136
176.1	1.045	.018	.136
180.0	1.041	.048	.136
188.9	1.051	.076	.130
196.0	1.048	.078	.129
204.0	1.049	.107	.119
206.9	1.049	.108	.119
212.4	1.043	.132	.106
220.0	1.040	.150	.091
228.0	1.051	.176	.076
236.7	1.050	.178	.055
236.7	1.048	.192	.055
244.6	1.055	.206	.037
247.6	1.060	.215	.016
260.0	1.066	.223	-.006
268.5	1.063	.225	-.027
276.5	1.060	.223	-.043
284.5	1.062	.216	-.066
292.0	1.061	.206	-.086
300.6	1.058	.191	-.103
308.7	1.060	.172	-.120
316.7	1.059	.166	-.130
320.0	1.059	.128	-.146
324.0	1.050	.121	-.146
328.0	1.063	.117	-.151
330.0	1.064	.117	-.151
332.0	1.067	.116	-.160
334.0	.995	.113	-.157
336.0	.996	.076	-.137
338.0	1.000	.031	-.126
340.0	1.067	.009	-.120
342.0	1.036	.066	-.120
344.0	1.022	.046	-.120
346.0	1.011	.030	-.117
348.0	1.011	.017	-.107
351.0	1.016	.009	-.101
353.0	1.010	-.008	-.090
355.1	1.010	-.027	-.079
356.0	1.010	-.035	-.076
357.0	1.007	-.036	-.076
359.3	1.007	-.037	-.076

RADIUS = .701

ANGLE	VX/V	VT/V	VR/V
-.7	1.038	-.023	-.101
3.5	1.036	-.036	-.099
11.6	1.043	-.061	-.109
13.0	1.051	-.065	-.111
15.0	1.062	-.069	-.112
15.5	1.061	-.067	-.115
17.0	1.068	-.072	-.115
19.6	1.070	-.078	-.115
21.0	1.085	-.062	-.116
23.0	1.098	-.063	-.115
23.3	1.074	-.038	-.113
25.6	1.081	-.035	-.113
25.0	1.012	-.043	-.109
25.3	1.003	-.041	-.113
27.0	1.022	-.127	-.127
27.7	1.028	-.139	-.132
29.3	1.083	-.128	-.142
31.0	1.092	-.118	-.142
33.2	1.089	-.106	-.130
35.7	1.086	-.111	-.136
39.2	1.081	-.171	-.128
43.0	1.086	-.133	-.117
51.9	1.082	-.156	-.099
55.8	1.092	-.169	-.081
59.6	1.090	-.171	-.079
67.0	1.092	-.106	-.055
75.9	1.091	-.195	-.032
78.9	1.106	-.196	-.025
83.9	1.098	-.200	-.008
91.9	1.101	-.200	.017
98.0	1.103	-.199	.035
99.9	1.099	-.198	.039
107.0	1.091	-.192	.062
115.9	1.087	-.183	.085
118.9	1.090	-.177	.090
123.3	1.089	-.169	.105
137.1	1.085	-.152	.125
139.0	1.086	-.135	.139
147.9	1.081	-.111	.156
155.9	1.080	-.087	.166
159.3	1.088	-.076	.172
164.0	1.081	-.060	.178
172.0	1.079	-.032	.181
179.0	1.080	-.005	.188
179.6	1.087	-.007	.187
179.7	1.086	-.006	.183
187.9	1.079	.019	.182
196.3	1.087	.030	.176
197.0	1.085	.044	.177
199.9	1.087	.057	.173
205.9	1.086	.069	.168
211.9	1.079	.096	.157
219.9	1.070	.115	.146
228.0	1.073	.137	.128
237.0	1.079	.156	.108
239.9	1.070	.163	.090
243.0	1.082	.167	.087
251.0	1.077	.179	.065
259.0	1.080	.185	.063
259.0	1.089	.185	.042
267.7	1.095	.188	.019
275.0	1.095	.187	-.006
279.0	1.080	.187	-.017
289.0	1.092	.186	-.031
291.0	1.086	.176	-.056
299.0	1.092	.161	-.075
299.5	1.087	.163	-.078
307.0	1.086	.167	-.100
317.0	1.081	.175	-.121
317.9	1.080	.118	-.126
319.7	1.076	.116	-.131
323.3	1.080	.103	-.136
325.3	1.089	.099	-.139
327.3	1.096	.101	-.142
329.0	1.091	.171	-.146
331.7	.979	.125	-.160
333.3	.988	.131	-.169
335.2	1.082	.019	-.169
337.3	1.091	.066	-.156
339.0	1.081	.056	-.156
339.3	1.091	.053	-.156
341.2	1.078	.051	-.156
341.2	1.079	.040	-.153
343.2	1.087	.002	-.151
345.2	1.061	.033	-.167
345.2	1.061	.037	-.167
347.0	1.068	.026	-.140
347.7	1.099	.022	-.130
355.6	1.027	-.017	-.111
357.6	1.036	-.010	-.111
359.3	1.030	-.023	-.101

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
-.1	1.003	.034	-.136
7.7	.960	-.003	-.138
15.6	.967	-.046	-.139
17.0	.971	-.056	-.140
19.6	.992	-.061	-.150
19.9	.988	-.064	-.157
21.0	1.005	-.066	-.156
23.0	1.019	-.066	-.155
23.6	1.019	-.065	-.157
25.0	1.023	-.066	-.155
27.0	.973	-.069	-.160
29.0	.972	-.130	-.164
31.0	1.046	-.113	-.175
39.0	1.052	-.107	-.160
39.0	1.046	-.107	-.159
47.0	1.056	-.125	-.160
55.9	1.056	-.142	-.120
59.9	1.053	-.150	-.110
63.0	1.061	-.156	-.099
71.7	1.065	-.160	-.075
79.0	1.068	-.175	-.051
79.0	1.069	-.176	-.051
87.9	1.070	-.178	-.026
95.6	1.075	-.177	-.002
99.7	1.073	-.176	.009
103.5	1.073	-.173	.026
111.5	1.070	-.165	.048
119.0	1.056	-.156	.075
119.5	1.050	-.156	.076
127.4	1.058	-.161	.098
135.6	1.058	-.176	.115
139.6	1.063	-.116	.126
147.0	1.051	-.105	.136
151.2	1.056	-.083	.147
159.2	1.058	-.068	.150
159.3	1.061	-.059	.150
167.2	1.067	-.036	.166
175.0	1.061	-.010	.170
179.3	1.056	.001	.171
183.3	1.060	.015	.169
191.0	1.067	.039	.166
199.3	1.058	.063	.162
199.6	1.060	.066	.162
207.0	1.060	.088	.153
215.2	1.059	.110	.138
219.2	1.062	.119	.132
223.2	1.052	.132	.125
231.1	1.058	.150	.106
238.0	1.049	.165	.085
238.0	1.062	.163	.086
246.0	1.056	.177	.063
250.0	1.067	.186	.030
258.0	1.070	.189	.026
262.9	1.060	.192	.016
270.9	1.069	.196	-.011
278.0	1.068	.196	-.033
278.9	1.060	.196	-.036
286.0	1.060	.190	-.058
296.0	1.063	.182	-.086
298.9	1.062	.176	-.097
302.9	1.058	.169	-.109
311.6	1.056	.151	-.135
319.1	1.056	.138	-.153
319.2	1.053	.130	-.156
325.0	1.055	.111	-.167
326.0	1.059	.112	-.169
327.7	1.065	.112	-.169
329.6	1.056	.131	-.176
331.6	.978	.143	-.178
333.7	.995	.079	-.196
335.0	1.068	.060	-.169
335.2	1.060	.063	-.165
337.6	1.072	.075	-.177
339.1	1.061	.082	-.170
341.6	1.059	.081	-.180
343.2	1.052	.081	-.179
351.3	1.039	.065	-.163
359.0	1.007	.036	-.135
359.3	1.006	.036	-.135
359.6	1.001	.036	-.136
359.9	1.003	.036	-.136

TABLE B-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 3

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	1.126	1.057	1.080	1.052	1.259	1.217	1.169	1.099	1.062	1.073	1.080	1.069	1.052
VTBAR	-.007	.012	-.008	.009	-.057	-.041	-.023	.002	.012	-.001	-.008	-.002	.009
VRBAR =	.008	-.008	.015	-.008	.056	.041	.023	-.000	-.009	.007	.015	.006	-.008
1-WVX =	1.180	1.119	1.097	1.086	0.000	1.237	1.210	1.163	1.128	1.107	1.098	1.093	1.086
1-WX =	1.224	1.135	1.107	1.093	0.000	1.308	1.263	1.195	1.146	1.119	1.108	1.101	1.093
BBAR =	30.23	21.36	18.05	14.38	44.74	40.05	34.87	27.31	22.51	19.82	17.65	15.61	13.87
BPOS =	3.91	2.29	1.42	.95	10.21	6.77	4.83	3.39	2.52	1.82	1.35	1.06	.90
THETA =	90.00	92.50	95.00	95.00	22.50	22.50	85.00	92.50	92.50	95.00	95.00	95.00	95.00
BNEG =	-3.83	-1.91	-2.31	-1.31	-11.87	-9.07	-6.17	-3.14	-2.17	-1.88	-2.32	-1.90	-1.26
THETA	0.00	335.00	332.50	332.50	0.00	0.00	0.00	337.50	335.00	332.50	332.50	332.50	332.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE B-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 3

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0367	.0358	.0234	.0190	.0143	.0099	.0050	.0026
PHASE ANGLE =	264.2	273.4	271.3	267.3	269.3	263.6	244.1	195.5
RADIUS = .633								
AMPLITUDE =	.0150	.0224	.0068	.0020	.0056	.0013	.0010	.0027
PHASE ANGLE =	323.3	268.9	255.5	266.1	262.2	283.8	13.9	31.2
RADIUS = .781								
AMPLITUDE =	.0103	.0147	.0093	.0025	.0029	.0040	.0007	.0012
PHASE ANGLE =	269.9	264.1	268.3	309.2	258.3	278.0	205.2	183.8
RADIUS = .963								
AMPLITUDE =	.0187	.0193	.0132	.0067	.0083	.0070	.0058	.0038
PHASE ANGLE =	261.6	254.1	234.9	191.4	213.7	193.4	175.5	174.1

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0044	.0058	.0068	.0057	.0054	.0030	.0009	.0019
PHASE ANGLE =	130.7	130.5	130.9	123.8	126.8	154.0	179.0	296.1
RADIUS = .633								
AMPLITUDE =	.0034	.0021	.0012	.0008	.0033	.0032	.0039	.0034
PHASE ANGLE =	73.2	40.2	146.1	288.0	279.1	261.3	252.6	271.8
RADIUS = .781								
AMPLITUDE =	.0007	.0027	.0019	.0016	.0038	.0027	.0028	.0003
PHASE ANGLE =	267.1	254.2	285.2	283.3	296.6	274.4	319.3	240.7
RADIUS = .963								
AMPLITUDE =	.0027	.0026	.0012	.0026	.0020	.0017	.0010	.0014
PHASE ANGLE =	165.9	169.4	196.8	260.4	205.3	298.0	133.4	43.5

TABLE B-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 3

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.0900	.0499	.0535	.0462	.0258	.0265	.0155	.0146
PHASE ANGLE =	245.6	275.9	275.9	269.5	272.0	262.5	235.2	201.9
RADIUS = .350								
AMPLITUDE =	.0730	.0459	.0441	.0378	.0224	.0213	.0122	.0108
PHASE ANGLE =	248.7	275.3	275.1	269.0	271.4	262.6	236.5	201.4
RADIUS = .400								
AMPLITUDE =	.0537	.0409	.0333	.0281	.0183	.0153	.0085	.0064
PHASE ANGLE =	254.3	274.5	273.6	268.3	270.5	262.9	239.1	200.1
RADIUS = .500								
AMPLITUDE =	.0269	.0320	.0172	.0130	.0116	.0065	.0029	.0005
PHASE ANGLE =	276.0	272.4	268.5	266.4	268.0	264.9	252.4	154.0
RADIUS = .600								
AMPLITUDE =	.0162	.0246	.0082	.0038	.0068	.0019	.0008	.0025
PHASE ANGLE =	313.7	269.9	258.7	264.2	263.9	277.8	346.3	31.6
RADIUS = .700								
AMPLITUDE =	.0116	.0177	.0080	.0026	.0039	.0032	.0006	.0008
PHASE ANGLE =	312.2	267.7	268.3	307.6	268.6	291.2	348.1	41.7
RADIUS = .800								
AMPLITUDE =	.0106	.0144	.0095	.0023	.0029	.0040	.0010	.0015
PHASE ANGLE =	284.5	262.9	266.6	303.6	251.8	272.5	195.9	185.4
RADIUS = .900								
AMPLITUDE =	.0145	.0159	.0112	.0029	.0051	.0046	.0036	.0031
PHASE ANGLE =	265.7	256.7	249.5	213.3	220.8	223.6	179.6	180.9
RADIUS = 1.000								
AMPLITUDE =	.0187	.0193	.0132	.0067	.0083	.0070	.0058	.0038
PHASE ANGLE =	261.6	254.1	234.9	191.4	213.7	193.4	175.5	174.1

TABLE B-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0100	.0157	.0131	.0156	.0185	.0107	.0082	.0044
PHASE ANGLE =	182.6	159.9	130.7	128.5	116.5	122.3	71.5	65.5
RADIUS = .350								
AMPLITUDE =	.0078	.0125	.0113	.0126	.0145	.0082	.0055	.0026
PHASE ANGLE =	173.7	154.2	130.7	128.4	117.9	126.0	75.5	53.8
RADIUS = .400								
AMPLITUDE =	.0057	.0069	.0091	.0091	.0098	.0054	.0025	.0012
PHASE ANGLE =	156.6	145.5	130.7	128.5	120.6	134.1	88.2	.9
RADIUS = .500								
AMPLITUDE =	.0040	.0042	.0052	.0035	.0027	.0020	.0021	.0028
PHASE ANGLE =	110.0	113.0	131.5	129.8	140.7	188.2	226.7	282.9
RADIUS = .600								
AMPLITUDE =	.0037	.0024	.0021	.0002	.0025	.0028	.0038	.0036
PHASE ANGLE =	79.3	58.5	137.6	228.2	270.4	254.0	247.3	273.4
RADIUS = .700								
AMPLITUDE =	.0011	.0012	.0009	.0012	.0039	.0030	.0030	.0017
PHASE ANGLE =	53.8	290.5	268.4	289.2	292.8	267.2	288.6	265.6
RADIUS = .800								
AMPLITUDE =	.0009	.0029	.0020	.0017	.0036	.0026	.0027	.0001
PHASE ANGLE =	255.3	250.0	284.9	281.3	295.9	276.1	324.1	172.1
RADIUS = .900								
AMPLITUDE =	.0017	.0026	.0014	.0022	.0020	.0021	.0012	.0010
PHASE ANGLE =	201.1	217.8	204.6	268.9	270.9	287.4	349.4	64.1
RADIUS = 1.000								
AMPLITUDE =	.0027	.0026	.0012	.0026	.0020	.0017	.0010	.0014
PHASE ANGLE =	165.9	169.4	196.8	260.4	205.3	298.0	133.4	43.5

TABLE B-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 3

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2359	.0054	.0027	.0040	.0046	.0036	.0034	.0031
PHASE ANGLE =	180.6	66.7	131.0	150.6	141.6	146.5	106.7	84.2
RADIUS = .633								
AMPLITUDE =	.2069	.0088	.0072	.0059	.0047	.0041	.0037	.0026
PHASE ANGLE =	183.6	289.5	285.4	279.2	279.7	272.4	292.2	282.0
RADIUS = .781								
AMPLITUDE =	.1932	.0037	.0042	.0027	.0034	.0020	.0022	.0013
PHASE ANGLE =	180.5	283.4	296.2	263.2	279.0	256.9	294.7	312.0
RADIUS = .963								
AMPLITUDE =	.1868	.0031	.0026	.0042	.0044	.0044	.0027	.0012
PHASE ANGLE =	178.5	154.7	127.2	125.1	106.3	104.2	89.7	62.6

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0050	.0045	.0002	.0051	.0042	.0026	.0012	.0010
PHASE ANGLE =	62.1	43.5	46.2	49.6	43.0	69.2	60.2	164.8
RADIUS = .633								
AMPLITUDE =	.0025	.0024	.0008	.0008	.0016	.0030	.0030	.0034
PHASE ANGLE =	297.0	287.0	268.2	211.6	167.1	163.9	163.1	156.5
RADIUS = .781								
AMPLITUDE =	.0019	.0008	.0002	.0006	.0013	.0018	.0014	.0015
PHASE ANGLE =	330.4	31.0	48.6	129.8	135.3	158.7	147.9	168.7
RADIUS = .963								
AMPLITUDE =	.0002	.0008	.0014	.0023	.0025	.0022	.0016	.0014
PHASE ANGLE =	21.6	212.2	206.4	191.3	172.3	153.9	124.6	46.0

TABLE B-6 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 3

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER : 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2717	.0308	.0212	.0213	.0196	.0165	.0161	.0137
PHASE ANGLE =	174.5	92.2	111.6	124.0	124.1	122.3	108.9	88.8
RADIUS = .350								
AMPLITUDE =	.2610	.0226	.0154	.0157	.0149	.0124	.0121	.0104
PHASE ANGLE =	176.3	90.2	112.8	126.2	125.8	124.5	108.7	88.5
RADIUS = .400								
AMPLITUDE =	.2483	.0134	.0087	.0095	.0095	.0077	.0076	.0066
PHASE ANGLE =	178.5	85.2	115.9	131.5	129.8	129.9	108.2	87.5
RADIUS = .500								
AMPLITUDE =	.2273	.0027	.0016	.0021	.0020	.0019	.0008	0010
PHASE ANGLE =	181.9	354.3	252.7	212.6	177.9	192.1	97.2	69.3
RADIUS = .600								
AMPLITUDE =	.2113	.0080	.0066	.0054	.0040	.0037	.0031	.0021
PHASE ANGLE =	183.6	292.5	283.6	276.5	275.2	268.4	292.6	283.0
RADIUS = .700								
AMPLITUDE =	.1997	.0065	.0061	.0047	.0047	.0034	.0033	.0020
PHASE ANGLE =	182.1	289.0	291.0	275.1	279.9	268.0	291.7	292.5
RADIUS = .800								
AMPLITUDE =	.1920	.0031	.0037	.0023	.0029	.0015	.0019	.0012
PHASE ANGLE =	180.2	280.0	297.1	256.8	278.3	250.4	296.8	318.9
RADIUS = .900								
AMPLITUDE =	.1878	.0014	.0002	.0019	.0010	.0019	.0008	.0008
PHASE ANGLE =	178.9	191.9	260.3	148.0	117.2	117.5	60.7	24.0
RADIUS = 1.000								
AMPLITUDE =	.1868	.0031	.0026	.0042	.0044	.0044	.0027	.0012
PHASE ANGLE =	178.5	154.7	127.2	125.1	106.3	104.2	89.7	62.6

TABLE B-6 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0169	.0162	.0160	.0154	.0136	.0096	.0079	.0047
PHASE ANGLE =	73.7	62.7	50.3	49.3	33.5	30.8	8.5	328.1
RADIUS = .350								
AMPLITUDE =	.0132	.0124	.0143	.0122	.0107	.0073	.0057	.0029
PHASE ANGLE =	72.4	60.4	49.7	49.3	34.6	35.0	11.6	326.4
RADIUS = .400								
AMPLITUDE =	.0089	.0082	.0101	.0085	.0073	.0047	.0031	.0009
PHASE ANGLE =	69.5	55.4	48.5	49.3	37.1	44.6	20.3	315.5
RADIUS = .500								
AMPLITUDE =	.0027	.0025	.0037	.0030	.0024	.0020	.0013	.0020
PHASE ANGLE =	46.4	20.5	42.5	50.4	54.5	106.1	129.8	158.0
RADIUS = .600								
AMPLITUDE =	.0020	.0022	.0005	.0003	.0013	.0028	.0028	.0033
PHASE ANGLE =	306.2	295.7	323.2	188.6	153.7	158.7	161.4	156.2
RADIUS = .700								
AMPLITUDE =	.0022	.0011	.0003	.0004	.0013	.0023	.0021	.0025
PHASE ANGLE =	314.3	321.7	324.7	154.9	146.1	162.1	159.0	164.1
RADIUS = .800								
AMPLITUDE =	.0018	.0009	.0002	.0006	.0013	.0018	.0013	.0013
PHASE ANGLE =	333.5	40.8	63.7	135.2	136.4	157.8	144.2	168.0
RADIUS = .900								
AMPLITUDE =	.0010	.0004	.0006	.0013	.0017	.0019	.0013	.0005
PHASE ANGLE =	348.9	94.4	190.3	176.1	157.3	154.4	127.1	84.8
RADIUS = 1.000								
AMPLITUDE =	.0002	.0008	.0014	.0023	.0025	.0022	.0016	.0014
PHASE ANGLE =	21.6	212.2	206.4	191.3	172.3	153.9	124.6	46.0

TABLE B-7

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 9

INPUT DATA

RADIUS = .456

ANGLE	VX/V	VT/V	VR/V
-1.0	1.014	.023	-.010
17.6	1.003	-.098	-.076
45.2	1.122	-.168	-.084
63.6	1.121	-.217	-.053
63.6	1.124	-.216	-.058
91.1	1.137	-.241	-.007
109.0	1.132	-.228	.031
135.0	1.129	-.170	.076
155.6	1.136	-.097	.099
179.7	1.131	-.003	.111
193.0	1.136	.055	.108
224.2	1.138	.159	.081
240.0	1.145	.196	.055
269.6	1.137	.225	.002
269.7	1.145	.224	-.002
286.1	1.143	.215	-.034
315.0	1.131	.148	-.081
331.0	1.121	.116	-.093
359.0	1.014	.023	-.010
361.0	1.014	.023	-.010

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
-.3	1.013	-.035	-.070
46.0	1.048	-.133	-.111
91.7	1.091	-.189	-.007
137.0	1.053	-.122	.102
137.0	1.056	-.121	.101
183.4	1.049	.032	.136
225.5	1.047	.168	.080
271.0	1.071	.225	-.032
315.7	1.059	.152	-.129
330.8	1.064	.117	-.155
340.0	1.047	.035	-.126
351.0	1.016	.005	-.101
358.0	1.014	-.035	-.074
359.7	1.013	-.035	-.070

RADIUS = .781

ANGLE	VX/V	VT/V	VR/V
2.9	1.015	-.025	-.092
48.7	1.052	-.137	-.104
89.1	1.063	-.190	.007
94.6	1.070	-.188	.023
133.2	1.058	-.136	.127
140.0	1.054	-.117	.142
179.0	1.075	.002	.182
179.0	1.076	.002	.182
225.5	1.075	.134	.135
271.4	1.092	.191	.013
316.0	1.072	.128	-.116
349.3	1.024	.025	-.127
351.3	1.020	.016	-.121
355.6	1.027	-.017	-.111
362.9	1.015	-.025	-.092

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
-.5	1.011	.036	-.135
-1.0	1.009	.036	-.137
45.5	1.050	-.120	-.145
91.2	1.071	-.177	-.014
135.1	1.056	-.124	.115
180.9	1.066	.009	.169
225.1	1.066	.133	.119
271.0	1.074	.193	-.011
316.0	1.063	.135	-.146
359.0	1.009	.036	-.137
359.5	1.011	.036	-.135
360.5	1.011	.036	-.135

TABLE B-8 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 9

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET   JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	1.116	1.055	1.064	1.057	1.224	1.191	1.152	1.094	1.060	1.060	1.064	1.061	1.057
VTBAR =	-.007	.011	-.000	.008	-.047	-.034	-.020	.001	.011	.004	-.000	.002	.008
VRBAR =	.006	-.009	.016	-.008	.054	.038	.021	-.002	-.010	.007	.016	.007	-.008
1-WVX =	1.160	1.109	1.088	1.077	0.000	1.207	1.185	1.147	1.117	1.097	1.088	1.082	1.077
1-WX =	1.196	1.122	1.095	1.082	0.000	1.265	1.229	1.172	1.132	1.107	1.095	1.088	1.082
BBAR =	30.01	21.31	17.76	14.44	43.73	39.31	34.42	27.20	22.48	19.58	17.37	15.49	13.93
BPOS =	3.79	2.23	1.13	.84	6.42	5.44	4.50	3.34	2.49	1.57	1.07	.84	.79
THETA =	90.00	92.50	102.50	90.00	105.00	102.50	95.00	90.00	92.50	97.50	102.50	100.00	90.00
BNEG =	-2.69	-1.26	-.98	-.74	-9.28	-6.94	-4.55	-1.89	-1.40	-.84	-.99	-.90	-.71
THETA =	0.00	242.50	357.50	352.50	357.50	357.50	357.50	267.50	247.50	245.00	357.50	357.50	352.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE B-9 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 9

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0379	.0328	.0226	.0159	.0098	.0063	.0031	.0006
PHASE ANGLE =	254.5	256.8	247.0	237.5	236.2	221.4	179.6	24.2
RADIUS = .633								
AMPLITUDE =	.0079	.0222	.0093	.0027	.0042	.0033	.0019	.0016
PHASE ANGLE =	298.9	252.9	219.8	161.2	257.3	270.6	302.0	329.7
RADIUS = .781								
AMPLITUDE =	.0196	.0151	.0069	.0056	.0063	.0014	.0014	.0012
PHASE ANGLE =	228.3	267.9	269.9	345.6	274.0	258.9	296.3	292.3
RADIUS = .963								
AMPLITUDE =	.0165	.0167	.0095	.0029	.0033	.0015	.0009	.0005
PHASE ANGLE =	256.5	273.1	269.1	325.0	319.7	344.8	19.9	39.5

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0021	.0014	.0006	.0005	.0007	.0008	.0008	.0004
PHASE ANGLE =	47.3	17.2	44.4	92.3	135.5	133.8	128.7	132.9
RADIUS = .633								
AMPLITUDE =	.0013	.0010	.0006	.0008	.0002	.0001	.0002	.0001
PHASE ANGLE =	350.1	353.7	29.4	60.0	68.2	105.1	87.1	68.8
RADIUS = .781								
AMPLITUDE =	.0013	.0007	.0007	.0005	.0008	.0004	.0005	.0004
PHASE ANGLE =	278.3	255.3	282.7	291.9	267.3	268.9	279.7	275.9
RADIUS = .963								
AMPLITUDE =	.0002	.0001	.0003	.0001	.0003	.0002	.0001	.0001
PHASE ANGLE =	77.8	200.9	242.7	318.7	310.6	340.6	25.4	44.0

TABLE B-10 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 9

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.1039	.0435	.0460	.0400	.0203	.0132	.0106	.0022
PHASE ANGLE =	242.0	265.5	264.1	254.7	235.6	196.2	163.4	134.3
RADIUS = .350								
AMPLITUDE =	.0828	.0404	.0386	.0324	.0170	.0109	.0083	.0015
PHASE ANGLE =	244.1	263.0	260.6	251.5	235.4	200.9	165.3	125.8
RADIUS = .400								
AMPLITUDE =	.0590	.0367	.0302	.0238	.0133	.0084	.0056	.0007
PHASE ANGLE =	247.9	259.9	255.0	246.1	235.3	209.0	169.5	97.8
RADIUS = .500								
AMPLITUDE =	.0254	.0300	.0180	.0110	.0076	.0051	.0017	.0009
PHASE ANGLE =	262.8	254.7	239.5	227.7	238.0	233.8	200.4	356.1
RADIUS = .600								
AMPLITUDE =	.0101	.0240	.0109	.0040	.0046	.0036	.0016	.0015
PHASE ANGLE =	293.6	252.6	222.7	185.7	250.5	263.1	292.8	334.6
RADIUS = .700								
AMPLITUDE =	.0129	.0179	.0070	.0023	.0057	.0023	.0018	.0014
PHASE ANGLE =	239.7	259.4	243.6	350.2	266.6	262.7	296.4	307.4
RADIUS = .800								
AMPLITUDE =	.0204	.0147	.0071	.0060	.0063	.0012	.0013	.0012
PHASE ANGLE =	228.1	269.6	273.5	345.0	275.9	260.6	297.9	290.6
RADIUS = .900								
AMPLITUDE =	.0197	.0150	.0085	.0054	.0048	.0008	.0008	.0005
PHASE ANGLE =	237.0	274.3	276.8	339.5	291.6	317.4	330.6	304.0
RADIUS = 1.000								
AMPLITUDE =	.0165	.0167	.0095	.0029	.0033	.0015	.0009	.0005
PHASE ANGLE =	256.5	273.1	269.1	325.0	319.7	344.8	19.9	39.5

TABLE B-10 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0035	.0012	.0003	.0014	.0016	.0016	.0015	.0008
PHASE ANGLE =	77.5	37.5	258.2	230.6	179.7	149.1	148.3	176.8
RADIUS = .350								
AMPLITUDE =	.0031	.0013	.0001	.0009	.0013	.0014	.0013	.0007
PHASE ANGLE =	70.7	30.2	334.7	222.6	171.0	145.7	143.7	167.3
RADIUS = .400								
AMPLITUDE =	.0026	.0014	.0004	.0003	.0010	.0011	.0010	.0005
PHASE ANGLE =	60.6	23.3	38.5	181.1	156.1	140.5	137.0	152.2
RADIUS = .500								
AMPLITUDE =	.0018	.0014	.0007	.0007	.0006	.0006	.0006	.0003
PHASE ANGLE =	35.5	12.8	44.4	77.3	118.6	128.0	121.5	117.7
RADIUS = .600								
AMPLITUDE =	.0014	.0011	.0007	.0009	.0004	.0002	.0003	.0002
PHASE ANGLE =	3.1	.4	36.4	64.3	83.6	112.1	100.6	84.8
RADIUS = .700								
AMPLITUDE =	.0012	.0006	.0005	.0003	.0004	.0002	.0002	.0002
PHASE ANGLE =	304.5	301.3	318.5	357.5	269.7	259.5	280.4	281.4
RADIUS = .800								
AMPLITUDE =	.0013	.0007	.0008	.0006	.0008	.0004	.0005	.0004
PHASE ANGLE =	275.1	250.4	279.2	288.2	267.7	270.4	280.3	275.9
RADIUS = .900								
AMPLITUDE =	.0007	.0005	.0006	.0005	.0006	.0003	.0003	.0002
PHASE ANGLE =	265.9	235.5	265.5	282.7	275.8	286.5	292.9	283.9
RADIUS = 1.000								
AMPLITUDE =	.0002	.0001	.0003	.0001	.0003	.0002	.0001	.0001
PHASE ANGLE =	77.8	200.9	242.7	318.7	310.6	340.6	25.4	44.0

TABLE B-11 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 9

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2333	.0027	.0030	.0039	.0046	.0028	.0022	.0014
PHASE ANGLE =	181.0	95.4	170.2	161.9	161.4	166.2	127.5	69.0
RADIUS = .633								
AMPLITUDE =	.2047	.0105	.0074	.0063	.0048	.0039	.0037	.0024
PHASE ANGLE =	184.2	281.9	271.3	263.9	275.6	303.8	334.7	.8
RADIUS = .781								
AMPLITUDE =	.1873	.0015	.0044	.0021	.0022	.0020	.0011	.0012
PHASE ANGLE =	181.3	305.1	304.1	273.6	269.7	259.4	286.7	294.9
RADIUS = .963								
AMPLITUDE =	.1813	.0025	.0037	.0032	.0023	.0022	.0022	.0017
PHASE ANGLE =	178.8	39.5	26.5	51.8	53.6	58.4	60.3	82.4

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0022	.0018	.0014	.0011	.0011	.0010	.0009	.0006
PHASE ANGLE =	70.0	63.1	83.8	95.8	109.8	114.9	115.2	119.4
RADIUS = .633								
AMPLITUDE =	.0017	.0015	.0013	.0013	.0014	.0014	.0013	.0012
PHASE ANGLE =	39.3	65.1	102.0	143.2	175.7	205.6	237.0	255.4
RADIUS = .781								
AMPLITUDE =	.0010	.0008	.0008	.0006	.0006	.0005	.0005	.0005
PHASE ANGLE =	277.9	293.1	304.5	305.1	304.1	302.0	316.8	320.9
RADIUS = .963								
AMPLITUDE =	.0013	.0008	.0005	.0004	.0004	.0004	.0004	.0004
PHASE ANGLE =	103.3	101.2	98.6	93.3	88.0	78.8	71.7	89.7

TABLE B-12 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 9

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2652	.0329	.0179	.0191	.0190	.0154	.0139	.0050
PHASE ANGLE =	174.9	99.5	108.7	114.2	132.1	147.7	147.3	152.0
RADIUS = .350								
AMPLITUDE =	.2558	.0232	.0128	.0139	.0144	.0113	.0101	.0035
PHASE ANGLE =	176.8	99.4	112.9	118.2	135.1	149.0	145.8	143.6
RADIUS = .400								
AMPLITUDE =	.2446	.0124	.0071	.0082	.0091	.0068	.0059	.0020
PHASE ANGLE =	178.9	99.0	124.3	128.5	142.1	152.5	142.0	121.1
RADIUS = .500								
AMPLITUDE =	.2253	.0031	.0035	.0033	.0028	.0011	.0008	.0017
PHASE ANGLE =	182.3	284.2	232.2	215.3	201.5	232.4	36.6	35.7
RADIUS = .600								
AMPLITUDE =	.2094	.0101	.0070	.0060	.0044	.0035	.0034	.0024
PHASE ANGLE =	184.1	281.7	266.9	259.9	270.2	302.9	337.8	6.6
RADIUS = .700								
AMPLITUDE =	.1954	.0056	.0059	.0043	.0037	.0030	.0022	.0016
PHASE ANGLE =	182.8	283.7	283.5	264.9	271.2	281.8	315.2	327.9
RADIUS = .800								
AMPLITUDE =	.1859	.0010	.0041	.0016	.0019	.0018	.0009	.0011
PHASE ANGLE =	180.9	329.6	310.3	280.2	270.9	255.0	281.0	290.0
RADIUS = .900								
AMPLITUDE =	.1815	.0021	.0032	.0015	.0007	.0003	.0006	.0002
PHASE ANGLE =	179.5	53.7	355.4	39.6	25.8	79.8	65.6	71.5
RADIUS = 1.000								
AMPLITUDE =	.1813	.0025	.0037	.0032	.0023	.0022	.0022	.0017
PHASE ANGLE =	178.8	39.5	26.5	51.8	53.6	58.4	60.3	82.4

TABLE B-12 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0020	.0008	.0015	.0028	.0036	.0041	.0047	.0042
PHASE ANGLE =	130.7	320.3	350.3	6.3	33.8	55.9	76.0	84.8
RADIUS = .350								
AMPLITUDE =	.0019	.0007	.0011	.0019	.0025	.0030	.0034	.0030
PHASE ANGLE =	109.9	18.0	17.2	18.1	42.6	61.8	79.5	87.4
RADIUS = .400								
AMPLITUDE =	.0020	.0012	.0011	.0012	.0015	.0018	.0020	.0017
PHASE ANGLE =	87.0	52.6	58.6	48.5	64.6	76.3	88.0	93.8
RADIUS = .500								
AMPLITUDE =	.0022	.0019	.0016	.0013	.0012	.0010	.0006	.0004
PHASE ANGLE =	61.0	66.2	93.0	118.3	140.4	157.5	173.4	203.0
RADIUS = .600								
AMPLITUDE =	.0019	.0018	.0015	.0015	.0015	.0014	.0012	.0012
PHASE ANGLE =	45.2	66.8	101.3	139.2	170.0	199.0	230.9	250.9
RADIUS = .700								
AMPLITUDE =	.0008	.0005	.0002	.0002	.0005	.0007	.0007	.0008
PHASE ANGLE =	335.8	6.7	33.2	185.9	215.9	239.2	264.7	279.4
RADIUS = .800								
AMPLITUDE =	.0010	.0008	.0008	.0007	.0006	.0006	.0005	.0005
PHASE ANGLE =	272.4	288.7	303.0	308.3	311.6	312.3	328.0	331.3
RADIUS = .900								
AMPLITUDE =	.0003	.0003	.0004	.0004	.0004	.0004	.0004	.0004
PHASE ANGLE =	207.9	273.0	309.8	331.2	343.7	359.0	20.2	33.2
RADIUS = 1.000								
AMPLITUDE =	.0013	.0008	.0005	.0004	.0004	.0004	.0004	.0004
PHASE ANGLE =	103.3	101.2	98.6	93.3	88.0	78.8	71.7	89.7

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APPENDIX C

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS FOR EXPERIMENT 4

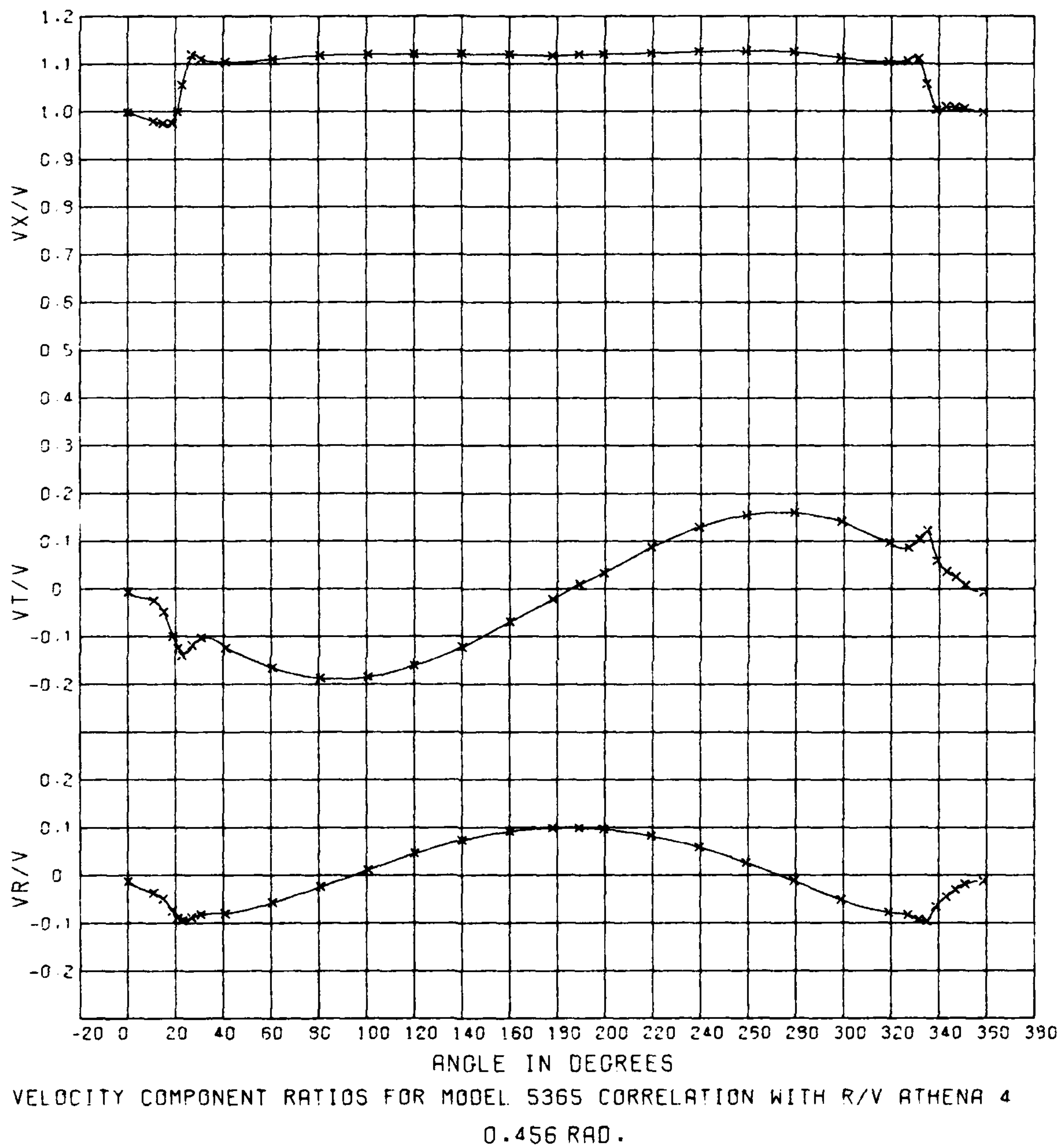

Figure C-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 4

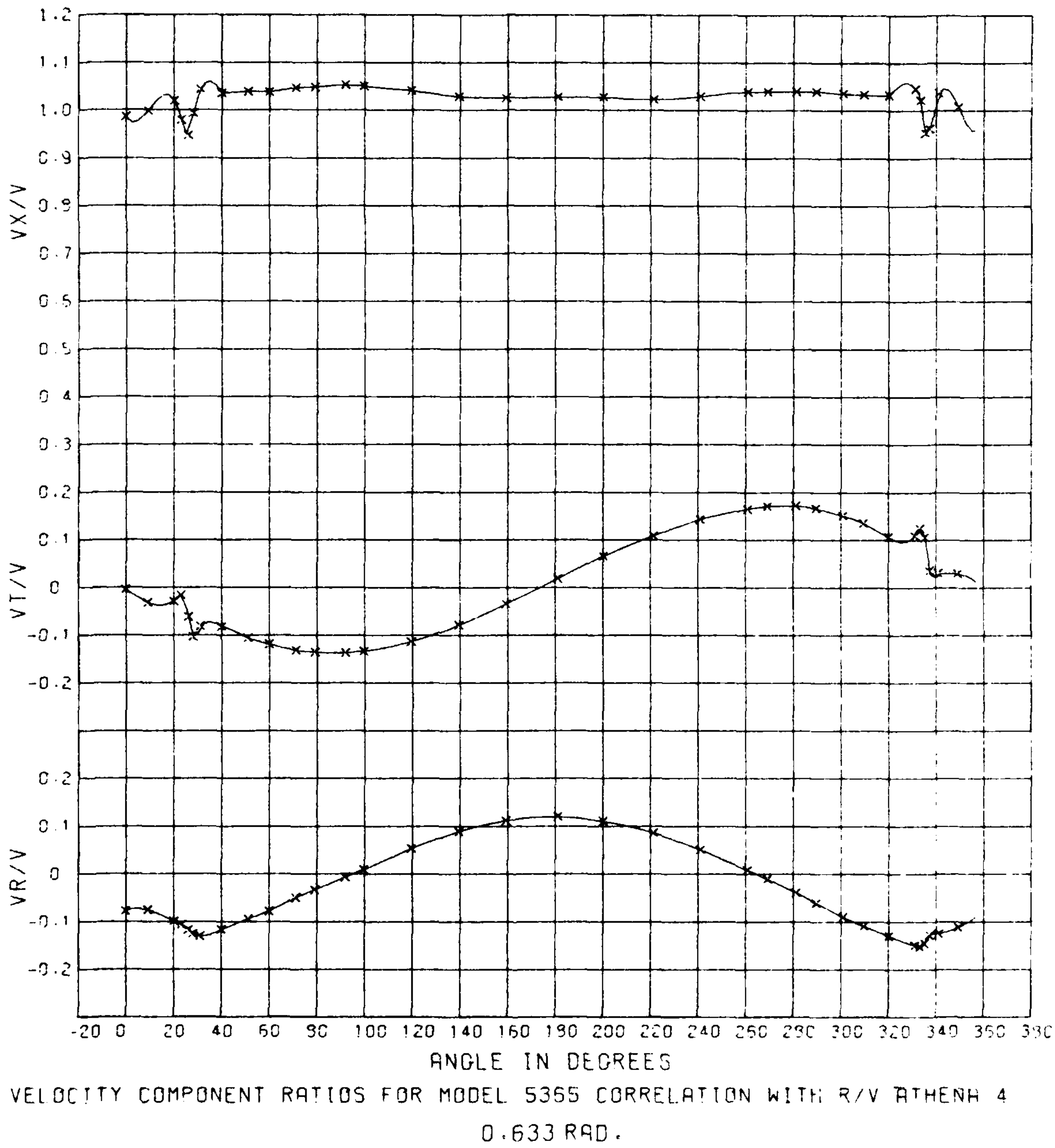

Figure C-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 4

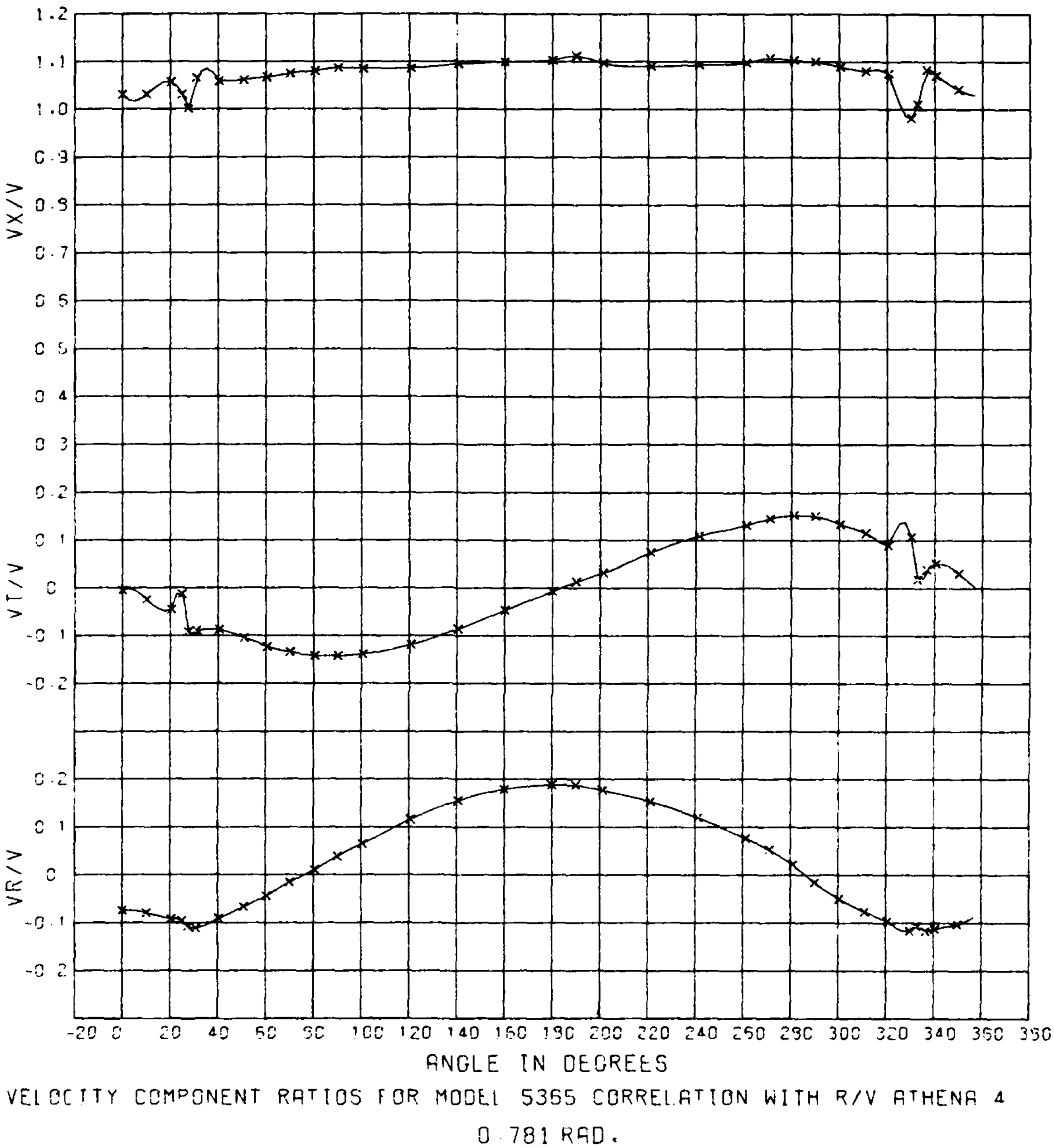

Figure C-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 4

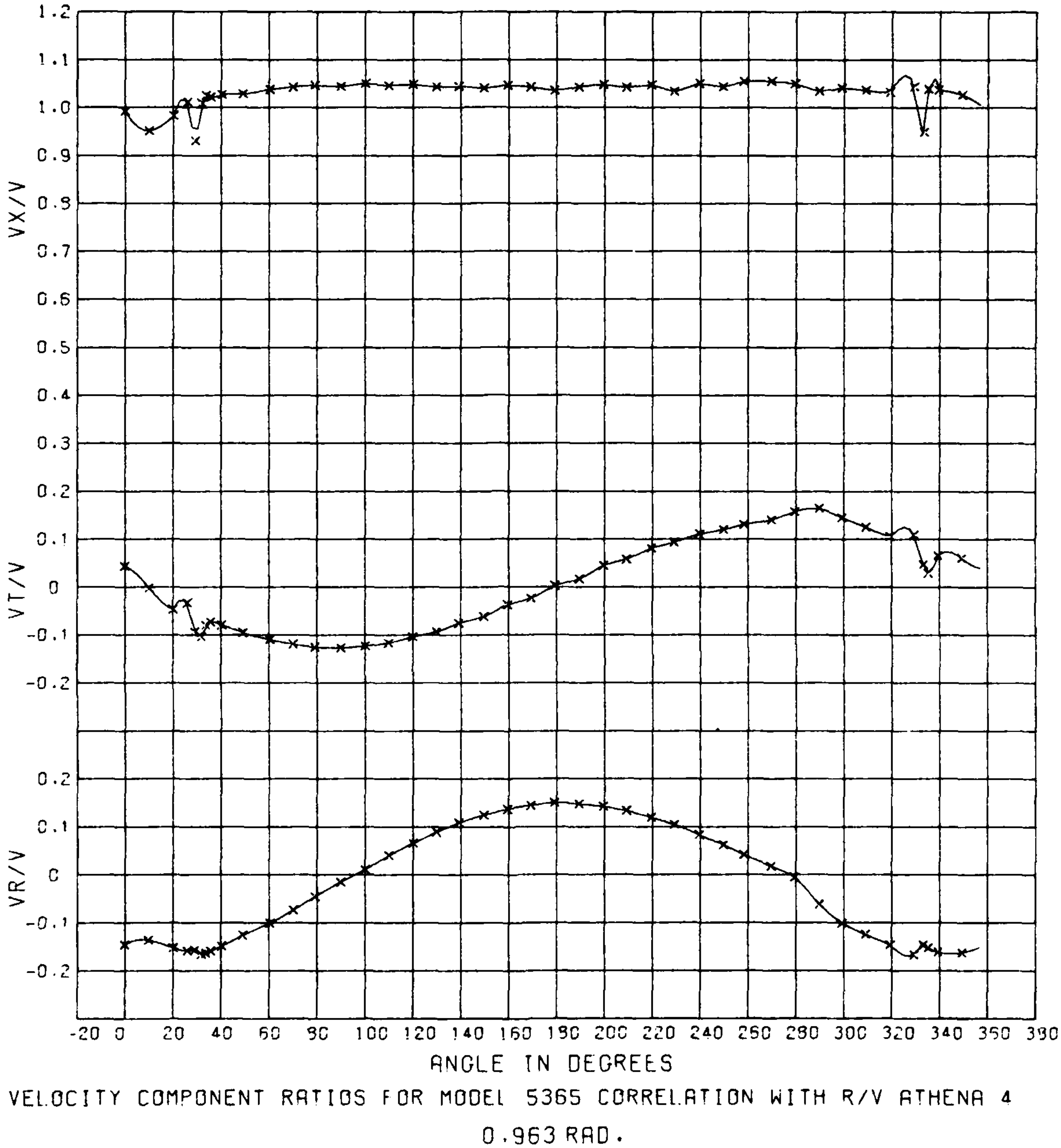

Figure C-4 – Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 4

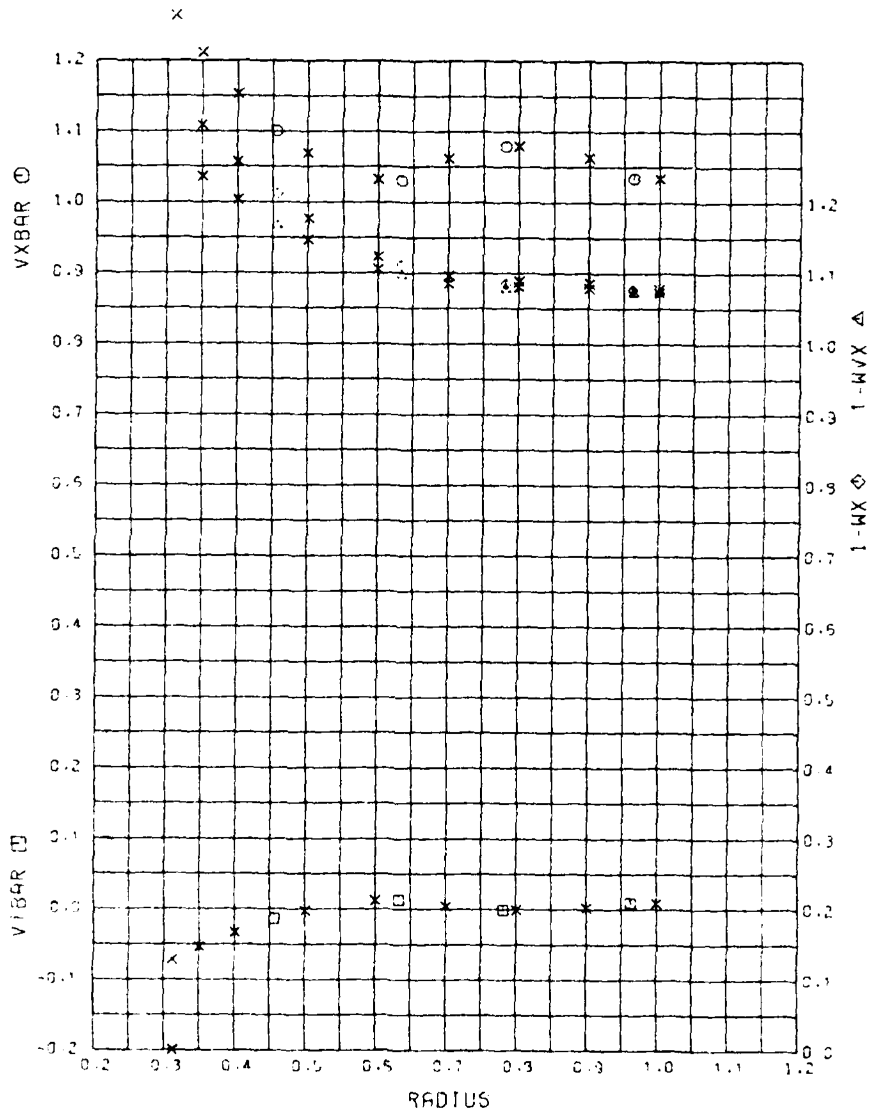

Figure C-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 4

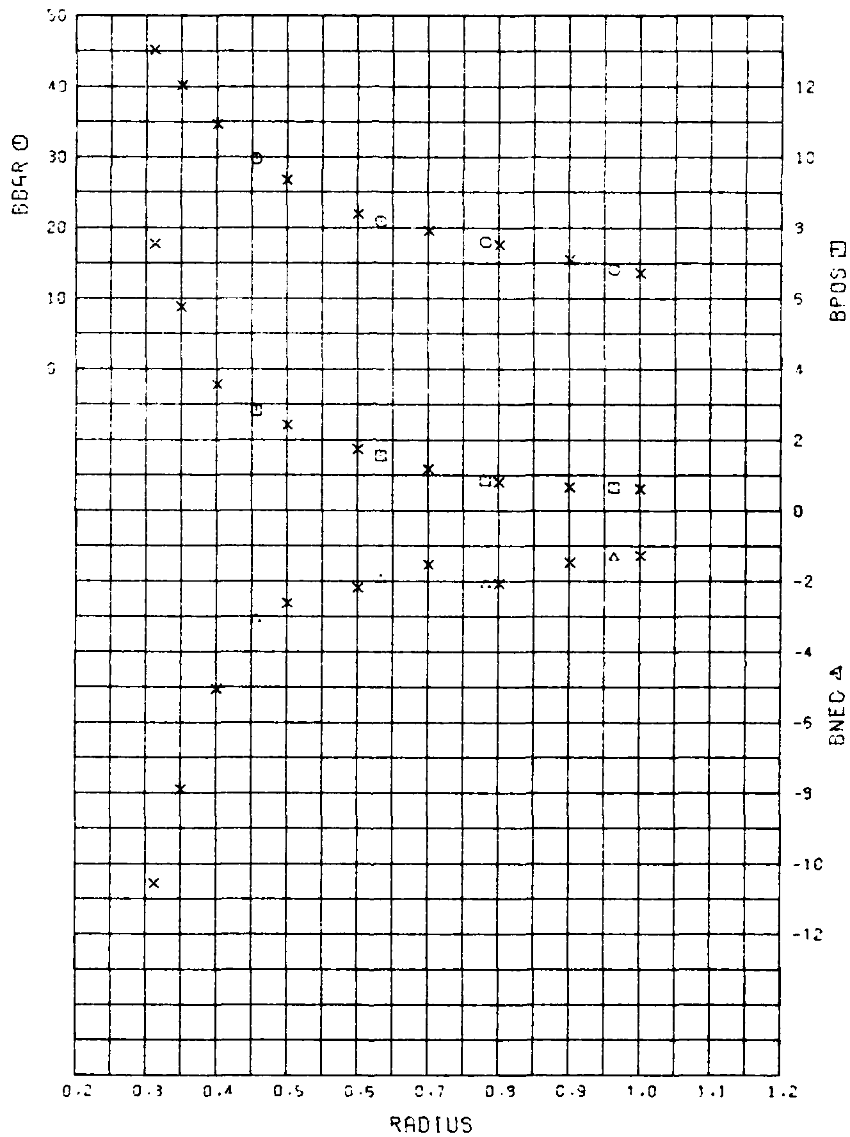

Figure C-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 4

TABLE C-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 4

RADIUS = .656

ANGLE	VX/V	VT/V	VR/V
0.0	.998	-.007	-.013
10.0	.979	-.025	-.037
14.8	.975	-.049	-.058
18.6	.975	-.100	-.076
20.7	.999	-.125	-.090
22.7	1.055	-.140	-.094
26.6	1.118	-.118	-.088
30.6	1.118	-.103	-.092
40.7	1.103	-.125	-.080
60.6	1.109	-.166	-.057
80.6	1.117	-.187	-.024
100.6	1.120	-.185	.011
120.0	1.120	-.161	.046
140.0	1.120	-.122	.074
160.0	1.120	-.069	.092
178.0	1.117	-.022	.098
189.0	1.119	.010	.099
199.3	1.120	.033	.097
219.3	1.122	.088	.092
239.3	1.125	.130	.059
259.1	1.127	.155	.026
279.1	1.125	.161	-.017
298.9	1.113	.141	-.052
318.9	1.106	.097	-.078
327.0	1.106	.087	-.092
333.0	1.115	.098	-.090
337.0	1.107	.111	-.095
336.9	1.057	.122	-.097
338.8	1.003	.059	-.065
347.9	1.010	.037	-.045
346.7	1.008	.026	-.030
350.7	1.006	.008	-.019
358.5	.998	-.006	-.017
360.0	.998	-.007	-.013

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
-.3	.985	-.004	-.078
9.0	.998	-.032	-.076
19.9	1.020	-.038	-.099
23.0	.979	-.016	-.107
25.9	.967	-.063	-.118
27.9	.993	-.106	-.126
31.0	1.044	-.081	-.131
39.8	1.036	-.082	-.117
51.0	1.039	-.107	-.096
59.8	1.038	-.119	-.078
71.0	1.046	-.131	-.050
79.0	1.049	-.135	-.036
91.8	1.053	-.137	-.007
99.6	1.050	-.136	.009
119.6	1.041	-.114	.053
139.6	1.029	-.079	.089
159.2	1.026	-.035	.111
181.0	1.028	.019	.120
200.0	1.028	.066	.110
221.1	1.023	.109	.086
221.1	1.022	.109	.086
240.7	1.029	.143	.058
260.6	1.039	.165	.008
269.0	1.039	.171	-.011
281.0	1.040	.172	-.039
289.6	1.040	.167	-.061
300.7	1.036	.152	-.090
309.6	1.036	.136	-.110
320.0	1.032	.107	-.138
331.0	1.046	.109	-.150
333.2	1.073	.125	-.153
335.2	.953	.106	-.166
337.2	.963	.035	-.128
337.2	.960	.036	-.129
341.0	1.037	.031	-.126
349.1	1.007	.030	-.112
359.7	.985	-.004	-.078

RADIUS = .791

ANGLE	VX/V	VT/V	VR/V
0.0	1.031	-.005	-.076
10.0	1.030	-.025	-.078
20.4	1.057	-.065	-.092
24.8	1.032	-.011	-.096
24.8	1.029	-.016	-.095
26.7	.968	-.069	-.102
28.0	1.033	-.114	-.114
30.9	1.066	-.089	-.111
40.3	1.058	-.098	-.091
50.8	1.061	-.105	-.067
60.6	1.067	-.123	-.046
70.0	1.074	-.136	-.016
80.6	1.080	-.142	.010
90.0	1.086	-.143	.038
100.5	1.085	-.139	.066
120.6	1.085	-.119	.115
140.5	1.093	-.087	.155
140.5	1.095	-.087	.155
160.0	1.100	-.047	.179
180.0	1.110	-.006	.189
180.0	1.096	-.009	.186
190.0	1.111	.013	.187
201.2	1.096	.031	.176
221.2	1.090	.075	.153
241.3	1.093	.109	.120
241.3	1.093	.110	.120
261.1	1.097	.131	.076
271.0	1.109	.146	.057
281.0	1.103	.152	.021
290.0	1.100	.151	-.016
300.0	1.090	.135	-.050
300.7	1.089	.133	-.058
311.0	1.079	.115	-.077
320.6	1.075	.090	-.096
330.0	.982	.107	-.117
330.0	.980	.109	-.117
332.8	1.010	.018	-.107
336.6	1.083	.039	-.118
340.5	1.071	.051	-.113
350.0	1.042	.031	-.103
360.0	1.031	-.005	-.076

RADIUS = .967

ANGLE	VX/V	VT/V	VR/V
-.2	.992	.063	-.166
9.8	.951	-.003	-.137
20.1	.982	-.067	-.153
25.9	1.011	-.036	-.159
29.0	.931	-.096	-.158
31.9	1.309	-.106	-.167
33.7	1.025	-.080	-.166
35.7	1.322	-.076	-.160
40.2	1.077	-.090	-.149
49.0	1.028	-.095	-.177
60.2	1.037	-.109	-.181
69.9	1.042	-.119	-.076
79.0	1.046	-.125	-.066
89.8	1.044	-.127	-.015
99.9	1.050	-.123	.010
109.7	1.046	-.117	.042
119.8	1.048	-.105	.066
129.7	1.043	-.096	.099
139.0	1.045	-.076	.108
149.5	1.038	-.062	.125
149.5	1.041	-.062	.126
159.6	1.046	-.078	.137
169.2	1.043	-.026	.166
179.0	1.073	.003	.152
179.0	1.049	.003	.168
189.1	1.043	.016	.167
199.6	1.048	.066	.167
209.0	1.042	.057	.133
219.6	1.047	.081	.119
229.0	1.036	.093	.106
239.6	1.050	.110	.083
249.6	1.046	.119	.067
258.0	1.055	.131	.041
260.5	1.055	.140	.017
279.3	1.050	.158	-.026
289.5	1.036	.156	-.063
299.0	1.041	.145	-.102
309.0	1.037	.125	-.125
319.1	1.032	.105	-.147
329.7	1.043	.109	-.168
333.1	.969	.067	-.167
335.1	1.039	.029	-.153
339.2	1.037	.066	-.162
340.3	1.037	.066	-.161
349.7	1.027	.061	-.163
359.8	.992	.063	-.166

TABLE C-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 4

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 4
PROPELLER DIAMETER = 6.00 FEET CA = .730

RADIUS =	.456	.533	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	1.101	1.0[illegible]0	1.079	1.034	1.264	1.212	1.1[illegible]3	1.070	1.032	1.062	1.080	1.063	1.034
VTBAR =	-.014	.013	-.001	.009	-.072	-.054	-.033	-.003	.012	.004	-.001	.002	.009
VRBAR =	.007	-.009	.038	-.009	.016	.053	.028	-.005	-.012	.022	.039	.020	-.009
1-WVX =	1.167	1.096	1.077	1.072	0.000	1.236	1.2[illegible]3	1.117	1.105	1.085	1.081	1.079	1.073
1-WX =	1.212	1.111	1.085	1.077	0.000	1.309	1.2[illegible]7	1.177	1.123	1.096	1.089	1.086	1.078
BBAR =	2[illegible].77	20.84	18.00	14.14	45.21	40.18	34.65	2[illegible].74	21.93	19.60	17.61	15.51	13.64
BPOS =	2.82	1.[illegible]6	.86	.66	7.54	5.76	3.55	2.42	1.74	1.17	.81	.66	.62
THETA =	92.50	90.[illegible]0	92.50	100.00	25.00	25.00	25.00	9[illegible].50	90.00	90.00	92.50	100.00	100.00
BNEG =	-2.07	-1.[illegible]5	-2.09	-1.32	-10.[illegible]6	-7.90	-5.05	-[illegible].62	-2.18	-1.53	-2.07	-1.47	-1.27
THETA =	337.50	335.00	327.50	332.50	342.50	342.50	342.50	33[illegible].00	335.00	327.50	327.50	330.00	332.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE C-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 4

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 4
PROPELLER DIAMETER 6.50 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0368	.0369	.0201	[illegible]	.0114	.0086	.0039	.0024
PHASE ANGLE =	265.8	270.3	[illegible]	267.6	264.2	259.9	239.8	162.7
RADIUS = .633								
AMPLITUDE =	.0071	.0167	[illegible]	.0035	.0062	.0038	.0015	.0019
PHASE ANGLE =	303.3	263.4	[illegible]	272.1	261.3	271.5	266.3	341.3
RADIUS = .781								
AMPLITUDE =	.0279	.0122	.0099	[illegible]	.0011	.0020	.0049	.0032
PHASE ANGLE =	256.8	262.8	[illegible]	42.7	106.9	154.2	179.4	170.4
RADIUS = .963								
AMPLITUDE =	.0184	.0169	.0095	.0076	.0080	.0047	.0039	.0038
PHASE ANGLE =	257.0	249.3	226.2	202.3	203.7	215.4	157.5	177.0

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0051	.0065	.0072	.0065	.0050	.0029	.0010	.0018
PHASE ANGLE =	122.0	112.8	109.2	104.8	101.8	92.4	51.0	320.4
RADIUS = .633								
AMPLITUDE =	.0019	.0017	.0017	[illegible]	.0052	.0053	.0066	.0058
PHASE ANGLE =	20.0	4.4	318.0	[illegible]	275.7	268.9	267.2	268.7
RADIUS = .781								
AMPLITUDE =	.0049	.0044	.0047	.0060	.0052	.0050	.0023	.0021
PHASE ANGLE =	198.9	249.7	270.3	299.9	308.1	320.8	4.0	85.5
RADIUS = .963								
AMPLITUDE =	.0036	.0031	.0019	.0026	.0035	.0031	.0007	.0005
PHASE ANGLE =	161.8	197.5	[illegible]	217.6	206.0	239.5	208.2	298.5

TABLE C-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 4

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R V ATHENA 4
PROPELLER DIAMETER 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.1093	.0497	.0406	.029[illegible]	.0141	.0130	.0107	.0118
PHASE ANGLE =	257.7	274.5	288.6	271.9	265.9	242.9	207.4	164.3
RADIUS = .350								
AMPLITUDE =	.0860	.0441	.0340	.0252	.0137	.0117	.0083	.0087
PHASE ANGLE =	253.9	273.5	285.2	270.8	265.5	247.5	212.8	164.1
RADIUS = .400								
AMPLITUDE =	.0599	.0374	.0267	.0205	.0130	.0101	.0058	.0053
PHASE ANGLE =	261.2	272.1	275.8	269.3	264.9	253.5	223.0	163.7
RADIUS = .500								
AMPLITUDE =	.0234	.0264	.0162	.0122	.0108	.0074	.0030	.0007
PHASE ANGLE =	272.1	268.6	266.1	266.6	263.7	264.5	256.0	159.3
RADIUS = .600								
AMPLITUDE =	.0082	.0186	.0103	.0054	.0075	.0047	.0018	.0011
PHASE ANGLE =	301.0	264.6	294.8	267.5	262.1	271.5	275.8	343.0
RADIUS = .700								
AMPLITUDE =	.0188	.0138	.0092	.0028	.0017	.0011	.0031	.0013
PHASE ANGLE =	263.6	264.6	247.3	12.7	271.5	226.4	193.5	171.8
RADIUS = .800								
AMPLITUDE =	.0288	.0121	.0097	.0041	.0014	.0022	.0051	.0035
PHASE ANGLE =	256.1	261.7	2[illegible].8	47.0	116.9	154.3	177.7	170.7
RADIUS = .900								
AMPLITUDE =	.0264	.0139	.0077	.0020	.0040	.0032	.0046	.0041
PHASE ANGLE =	255.1	254.0	269.2	155.3	181.5	185.9	169.1	173.3
RADIUS = 1.000								
AMPLITUDE =	.0184	.0169	.0095	.0076	.0080	.0047	.0030	.0038
PHASE ANGLE =	257.0	249.3	226.2	202.3	203.7	215.4	157.6	177.0

TABLE C-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 4
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0180	.0168	.0187	.0200	.0223	.0211	.0197	.0147
PHASE ANGLE =	153.2	137.1	120.1	100.7	92.3	79.9	76.4	74.0
RADIUS = .350								
AMPLITUDE =	.0136	.0136	.0153	.0159	.0170	.0154	.0136	.0096
PHASE ANGLE =	148.9	132.6	118.1	101.5	93.6	81.2	76.1	70.5
RADIUS = .400								
AMPLITUDE =	.0089	.0099	.0112	.0111	.0108	.0088	.0069	.0042
PHASE ANGLE =	140.3	125.0	114.7	102 7	90.0	83.8	74.5	57.8
RADIUS = .500								
AMPLITUDE =	.0033	.0045	.0046	.0033	.0015	.0009	.0026	.0038
PHASE ANGLE =	96.2	98.7	172.1	107.9	123.3	229.9	269.5	282.1
RADIUS = .600								
AMPLITUDE =	.0023	.0019	.0010	.0021	.0043	.0057	.0065	.0001
PHASE ANGLE =	32.8	37.2	3.2	281.1	271.2	264.8	265.8	270.0
RADIUS = .700								
AMPLITUDE =	.0022	.0026	.0036	.0053	.0055	.0052	.0031	.0012
PHASE ANGLE =	203.7	269.7	281.6	298.4	298.5	299.8	296.9	271.5
RADIUS = .800								
AMPLITUDE =	.0053	.0046	.0047	.0058	.0050	.0048	.0023	.0024
PHASE ANGLE =	197.6	246.9	268.1	299.0	308.1	322.7	13.8	85.7
RADIUS = .900								
AMPLITUDE =	.0050	.0041	.0042	.0036	.0026	.0029	.0015	.0020
PHASE ANGLE =	185.7	228.2	243.8	279.7	276.4	303.3	39.5	83.2
RADIUS = 1.000								
AMPLITUDE =	.0036	.0031	.0019	.0026	.0035	.0031	.0007	.0005
PHASE ANGLE =	161.8	197.5	192.9	217.6	206.0	239.5	208.2	298.5

TABLE C-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 4

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH P/V ATHENA 4
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.1734	.0061	.0025	.0012	.0035	.0029	.0002	.0023
PHASE ANGLE =	179.2	180.9	[illegible]	174.3	179.9	173.7	220.2	17.3
RADIUS = .633								
AMPLITUDE =	.1521	.0060	.0047	.0020	.0011	.0012	.0011	.0015
PHASE ANGLE =	181.7	228.3	[illegible]	[illegible]	263.4	277.1	303.0	333.0
RADIUS = .781								
AMPLITUDE =	.1404	.0094	.0049	.0010	.0006	.0008	.0018	.0027
PHASE ANGLE =	176.9	193.0	311.7	319.5	47.1	174.3	325.3	13.0
RADIUS = .963								
AMPLITUDE =	.1365	.0108	.0011	.0033	.0055	.0042	.0017	.0024
PHASE ANGLE =	175.8	177.9	[illegible]	[illegible]	97.7	116.3	90.6	49.0

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0042	.0059	[illegible]	[illegible]	[illegible]	.0020	[illegible]	.0019
PHASE ANGLE =	16.2	15.8	17.7	[illegible]	[illegible]	[illegible]	283.8	232.4
RADIUS = .633								
AMPLITUDE =	.0014	.0009	[illegible]	[illegible]	[illegible]	[illegible]	.0042	[illegible]
PHASE ANGLE =	2.1	8.1	71.8	[illegible]	[illegible]	[illegible]	167.1	170.3
RADIUS = .781								
AMPLITUDE =	.0015	.0009	[illegible]	[illegible]	[illegible]	.0032	.0018	.0016
PHASE ANGLE =	43.3	110.3	170.2	[illegible]	191.0	206.7	[illegible]	307.9
RADIUS = .963								
AMPLITUDE =	.0031	.0026	[illegible]	[illegible]	.0024	.0020	.0014	.0012
PHASE ANGLE =	64.5	107.3	[illegible]	[illegible]	216.1	222.5	258.1	338.1

TABLE C-6 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 4

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 4
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.1980	.0171	.0083	.0145	.0091	.0096	.0011	.0064
PHASE ANGLE =	172.7	147.2	[illegible]	163.4	160.0	155.0	109.8	40.8
RADIUS = .350								
AMPLITUDE =	.1906	.0132	.0058	.0113	.0073	.0075	.0008	.0050
PHASE ANGLE =	174.7	151.5	118.6	164.7	163.4	157.5	115.5	37.5
RADIUS = .400								
AMPLITUDE =	.1819	.0091	.0030	.0076	.0053	.0050	.0004	.0035
PHASE ANGLE =	177.0	161.2	124.1	[illegible]	169.4	162.5	130.2	30.6
RADIUS = .500								
AMPLITUDE =	.1673	.0051	.0016	.0022	.0024	.0018	.0004	.0018
PHASE ANGLE =	180.5	202.1	[illegible]	[illegible]	192.7	192.4	272.9	1.7
RADIUS = .600								
AMPLITUDE =	.1555	.0057	.0042	.0016	.0012	.0012	.0009	.0015
PHASE ANGLE =	181.8	229.0	241.1	[illegible]	244.2	266.5	297.7	[illegible]
RADIUS = .700								
AMPLITUDE =	.1457	.0075	.0052	.0016	.0007	.0009	.0017	.0021
PHASE ANGLE =	179.2	206.5	306.5	306.3	291.0	251.0	315.3	358.0
RADIUS = .800								
AMPLITUDE =	.1395	.0097	.0047	[illegible]	.0008	.0010	.0017	.0027
PHASE ANGLE =	176.5	190.8	312.1	[illegible]	65.4	158.5	328.6	15.9
RADIUS = .900								
AMPLITUDE =	.1366	.0108	.0028	.0017	.0033	.0027	.0009	.0027
PHASE ANGLE =	175.5	182.2	307.1	[illegible]	92.3	124.0	[illegible]	32.8
RADIUS = 1.000								
AMPLITUDE =	.1365	.0108	.0011	.0033	.0055	.0042	.0017	.0024
PHASE ANGLE =	175.8	177.9	[illegible]	[illegible]	97.7	116.3	90.6	49.0

TABLE C-6 (Continued)

VELOCITY COMPONENT RATIOS [illegible] MODEL 5365 CORRELATION WITH [illegible] V ATHENA [illegible]
PROPELLER DIAMETER [illegible] FEET JA = [illegible]

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	[illegible]	[illegible]	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0090	.0130	[illegible]	[illegible]	.0121	.0129	.0116	[illegible]
PHASE ANGLE =	26.0	21.1	16.9	5.0	352.8	338.7	329.7	318.3
RADIUS = .350								
AMPLITUDE =	.0075	.0108	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PHASE ANGLE =	24.0	19.9	16.9	6.6	355.5	340.3	[illegible]	[illegible]
RADIUS = .400								
AMPLITUDE =	.0058	.0083	.0077	.0091	[illegible]	[illegible]	.0041	[illegible]
PHASE ANGLE =	20.8	18.2	17.0	9.5	[illegible]	343.8	324.6	[illegible]
RADIUS = .500								
AMPLITUDE =	.0032	.0043	[illegible]	[illegible]	[illegible]	.0066	[illegible]	[illegible]
PHASE ANGLE =	11.3	13.5	[illegible]	22.5	37.9	[illegible]	176.8	191.0
RADIUS = .600								
AMPLITUDE =	.0016	.0016	.0011	[illegible]	[illegible]	.0034	.0041	[illegible]
PHASE ANGLE =	2.3	7.8	35.0	112.7	147.0	158.6	166.6	171.3
RADIUS = .700								
AMPLITUDE =	.0013	.0005	.0012	[illegible]	[illegible]	.0023	[illegible]	[illegible]
PHASE ANGLE =	21.0	54.9	[illegible]	172.1	178.0	185.5	198.3	205.4
RADIUS = .800								
AMPLITUDE =	.0016	.0011	[illegible]	.0032	.0039	.0031	.0019	[illegible]
PHASE ANGLE =	47.4	113.1	[illegible]	184.5	193.2	210.3	[illegible]	[illegible]
RADIUS = .900								
AMPLITUDE =	.0024	.0020	.0026	[illegible]	[illegible]	.0027	[illegible]	[illegible]
PHASE ANGLE =	60.7	112.3	[illegible]	[illegible]	204.7	221.8	[illegible]	327.7
RADIUS = 1.000								
AMPLITUDE =	.0031	.0020	[illegible]	.0026	.0024	.0020	.0014	[illegible]
PHASE ANGLE =	64.5	107.3	[illegible]	[illegible]	216.1	222.5	258.1	[illegible]

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APPENDIX D

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

EXPERIMENT 5

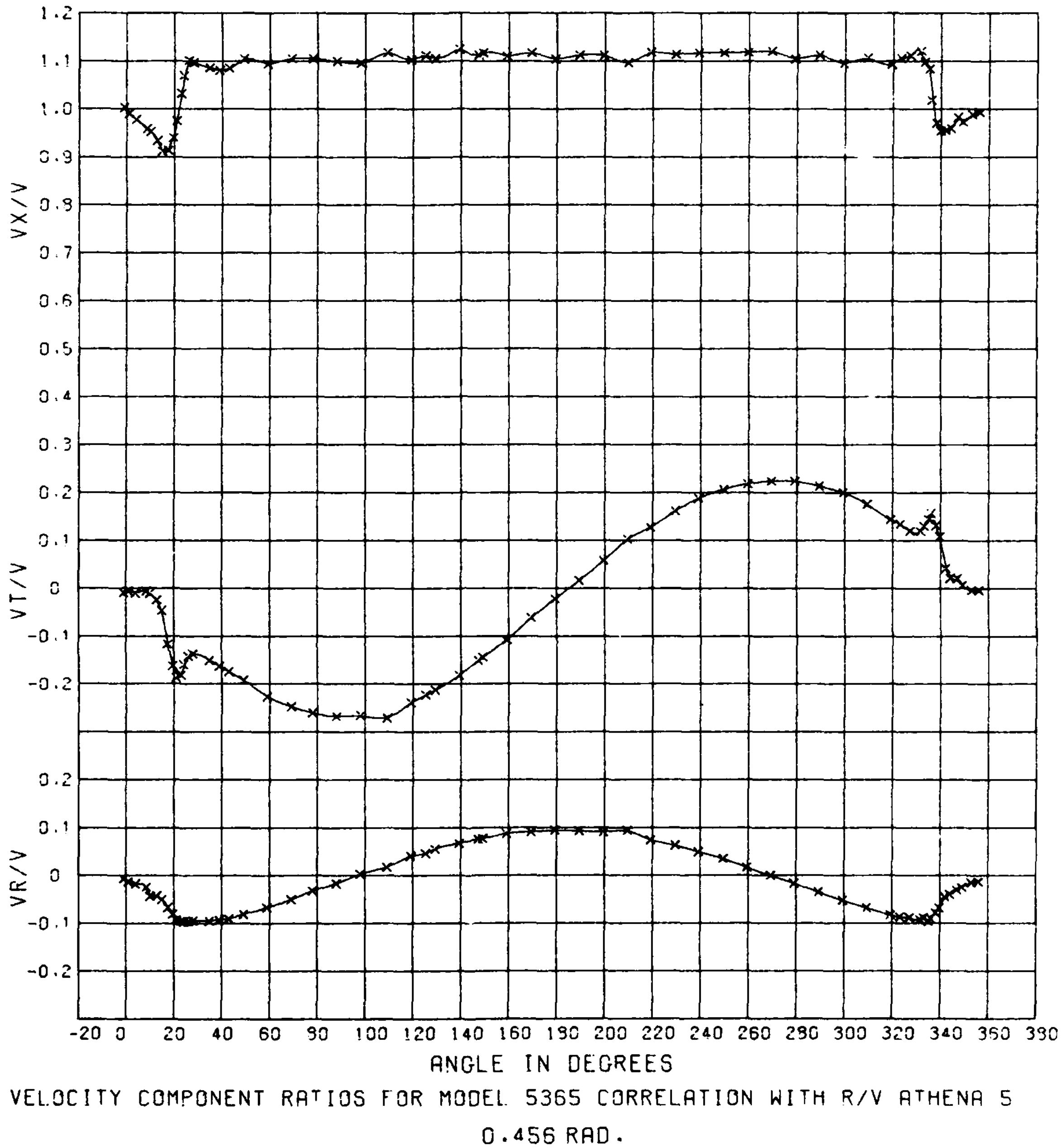

Figure D-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 5

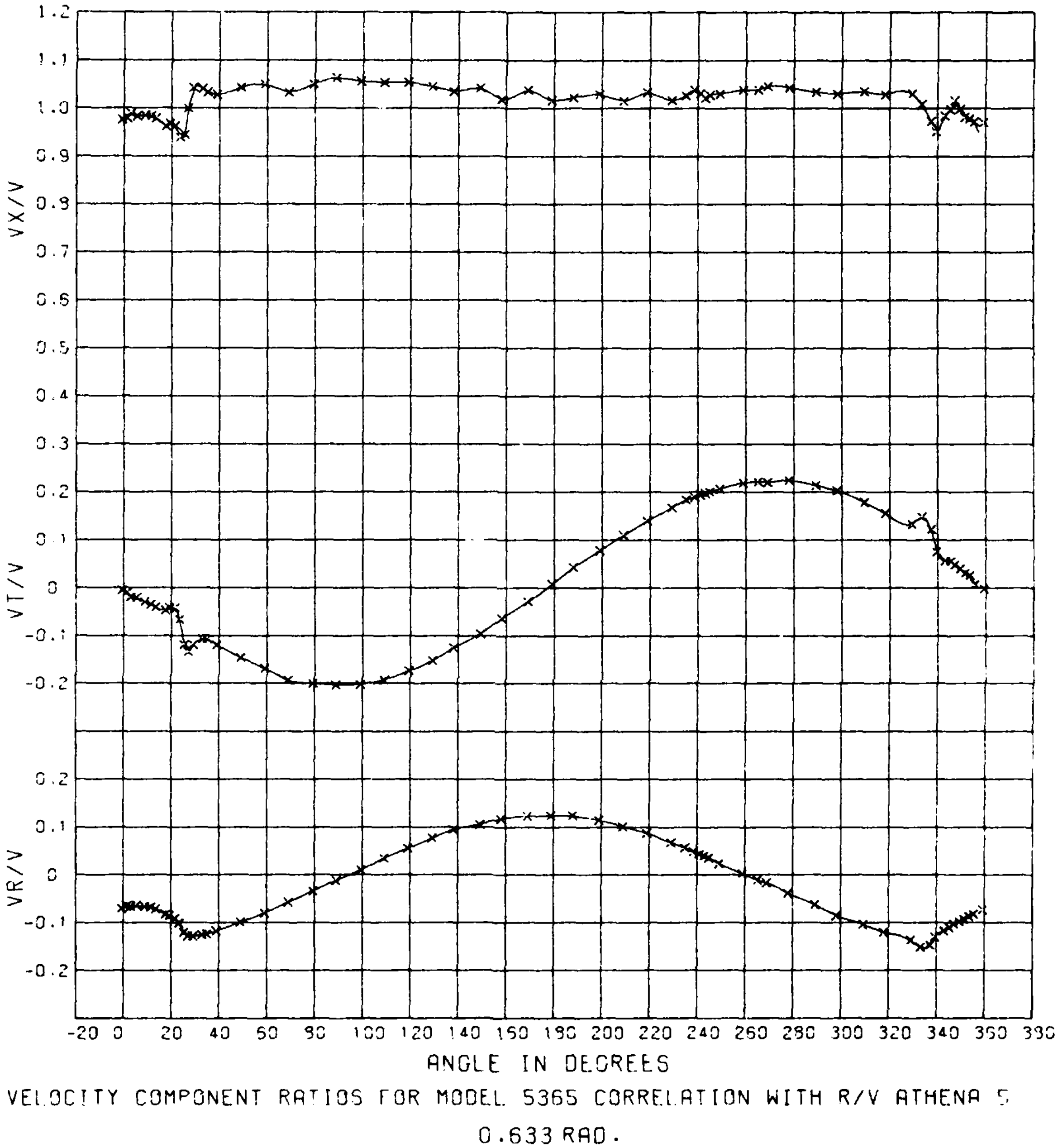

Figure D-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 5

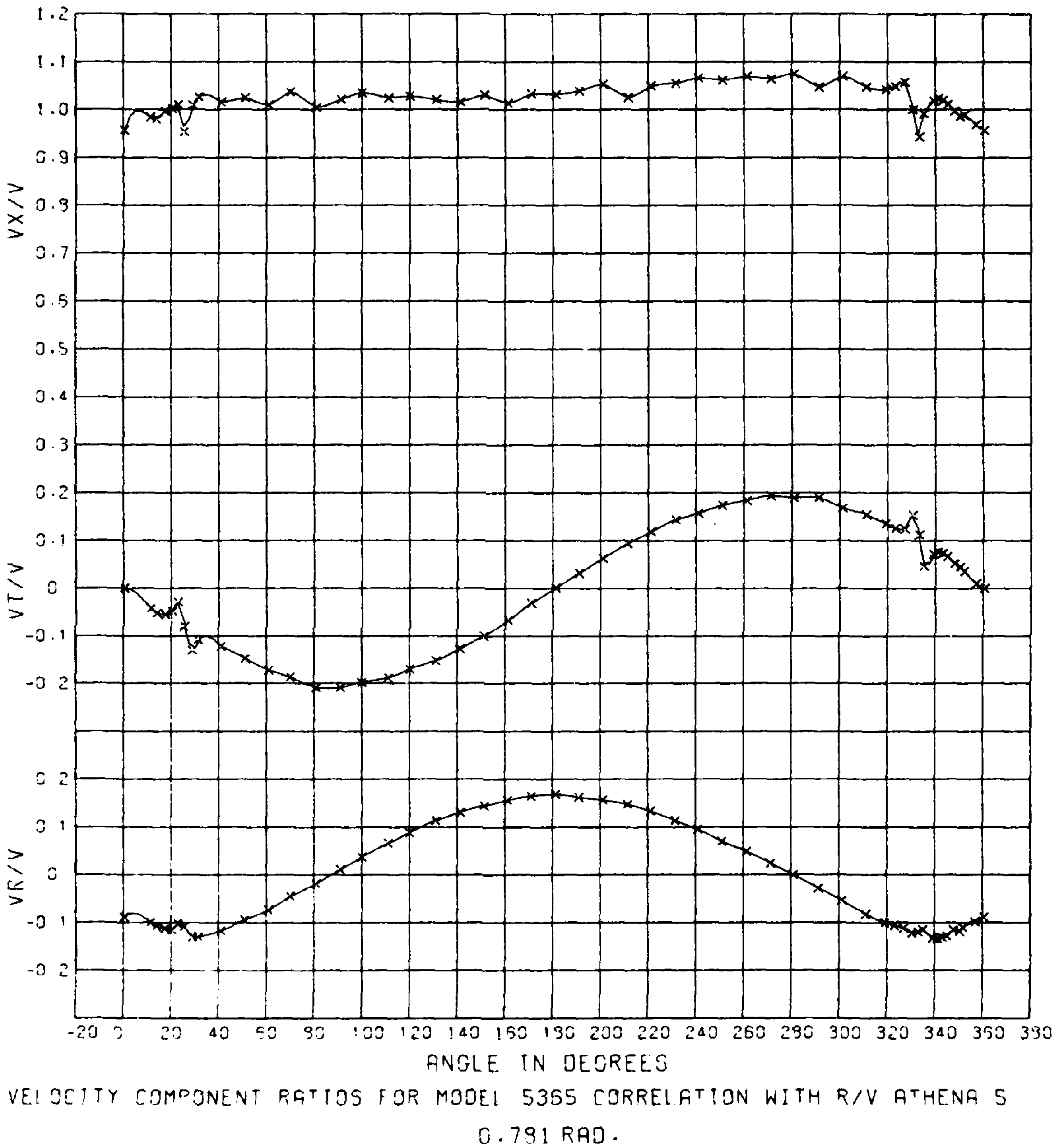

Figure D-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 5

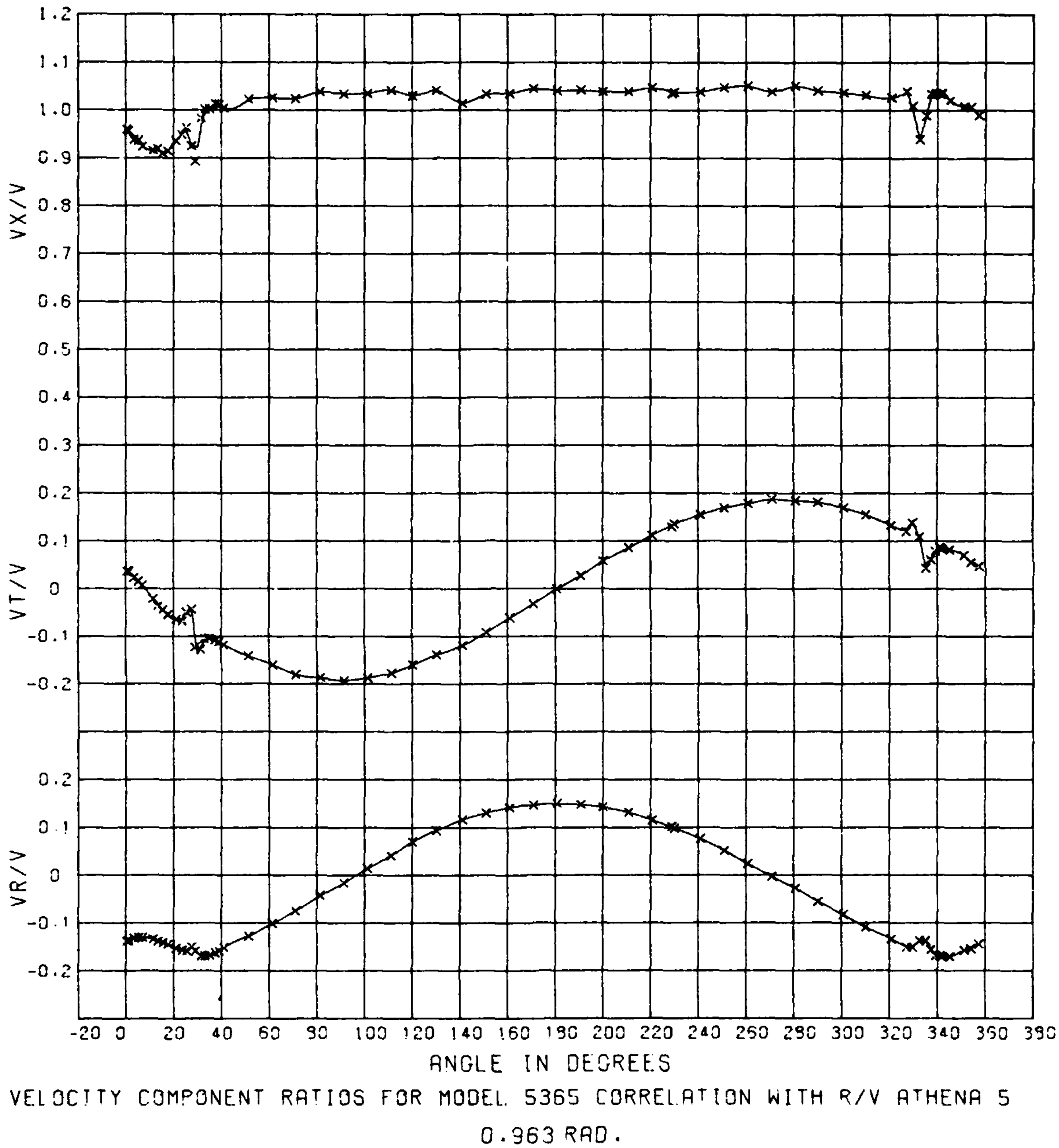

Figure D-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 5

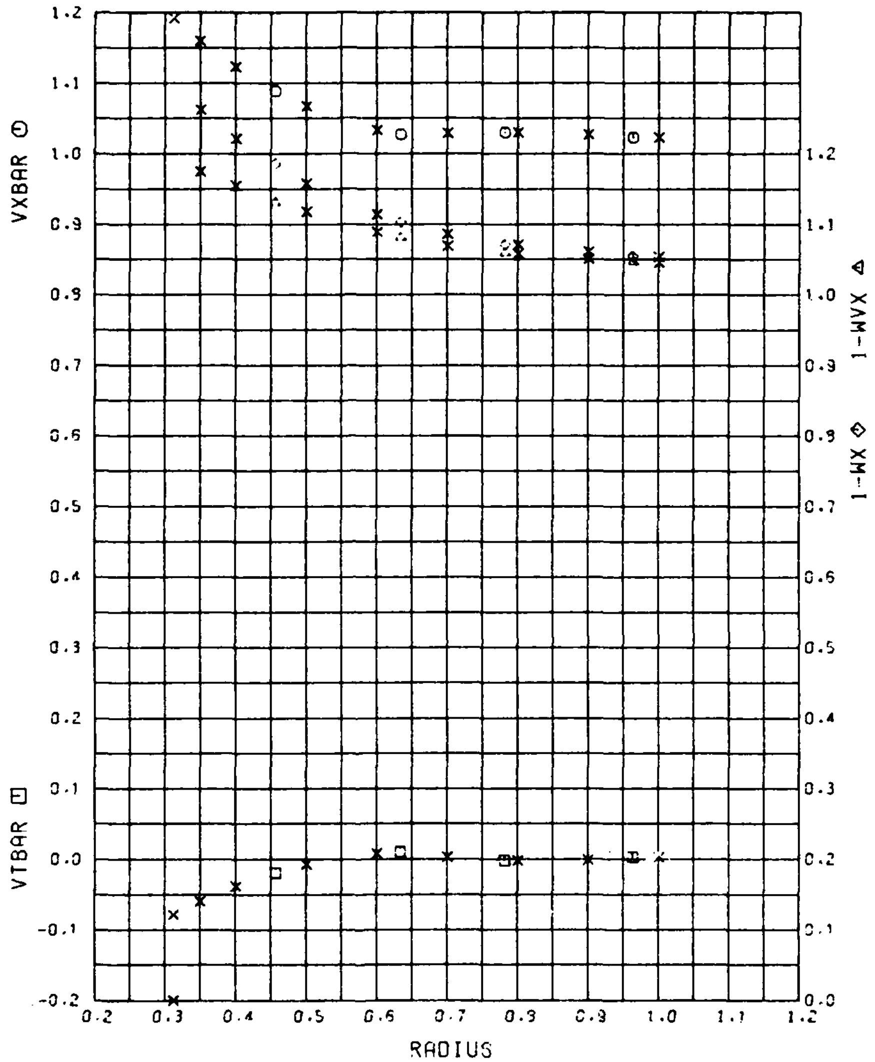

Figure D-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 5

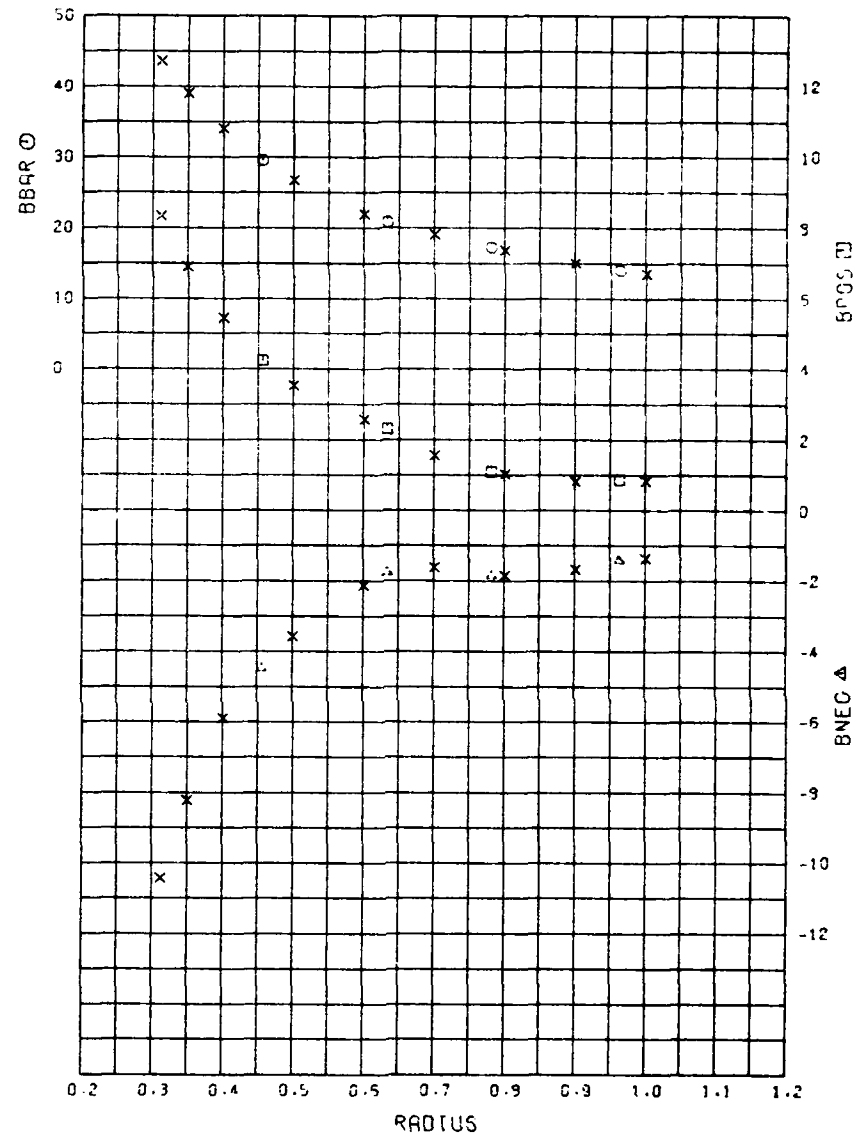

Figure D-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 5

TABLE D-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 5

RADIUS = .456

ANGLE	VX/V	VT/V	VR/V
-1.0	1.003	-.009	-.007
.9	.990	-.005	-.016
4.0	.978	-.010	-.019
8.0	.963	-.003	-.010
8.9	.956	-.004	-.052
10.0	.953	-.010	-.044
12.9	.936	-.025	-.043
14.9	.912	-.047	-.051
16.9	.893	-.066	-.055
18.0	.935	-.150	-.080
18.9	.978	-.166	-.077
20.0	.952	-.179	-.090
20.9	.975	-.188	-.093
22.9	1.009	-.181	-.090
22.9	1.055	-.181	-.102
26.0	1.051	-.158	-.044
26.2	1.087	-.182	-.098
26.0	1.101	-.163	-.095
29.0	1.093	-.130	-.095
29.0	1.100	-.137	-.094
34.8	1.096	-.151	-.095
38.9	1.079	-.163	-.095
39.9	1.086	-.165	-.090
42.9	1.085	-.176	-.091
49.0	1.104	-.192	-.092
50.9	1.096	-.227	-.064
59.0	1.105	-.267	-.051
70.0	1.105	-.240	-.033
80.0	1.100	-.248	-.017
90.0	1.096	-.246	.033
109.1	1.118	-.271	.017
119.0	1.103	-.299	.040
128.2	1.112	-.223	.046
129.2	1.125	-.215	.055
139.1	1.126	-.192	.067
147.2	1.113	-.151	.076
149.0	1.117	-.146	.077
159.0	1.116	-.108	.087
159.3	1.127	-.080	.091
169.3	1.107	-.063	.090
179.3	1.102	-.072	.095
179.3	1.107	-.071	.096
189.3	1.113	.016	.093
199.6	1.112	.054	.093
209.6	1.097	.103	.093
219.0	1.118	.127	.076
229.6	1.116	.167	.063
239.0	1.117	.188	.049
249.6	1.117	.206	.036
259.6	1.114	.214	.017
269.3	1.128	.276	-.000
279.0	1.105	.276	-.017
289.2	1.112	.213	-.036
299.2	1.098	.208	-.053
309.2	1.107	.178	-.068
319.1	1.193	.166	-.083
323.1	1.105	.136	-.087
327.1	1.111	.170	-.089
331.1	1.171	.116	-.091
332.0	1.171	.176	-.096
333.0	1.090	.130	-.080
335.0	1.077	.168	-.093
335.0	1.091	.167	-.100
336.0	1.016	.155	-.086
336.0	1.021	.159	-.095
338.0	.960	.126	-.059
338.0	.976	.136	-.076
339.0	.966	.135	-.077
340.0	.957	.081	-.050
342.0	.956	.062	-.065
344.0	.960	.071	-.100
346.9	.982	.078	-.031
349.0	.966	.097	-.027
349.0	.990	.006	-.026
357.9	.980	-.006	-.015
358.0	.993	-.006	-.016
359.0	1.003	-.009	-.107

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
-.7	.976	-.005	-.071
1.6	.979	-.009	-.066
3.8	.989	-.020	-.066
5.5	.983	-.020	-.064
9.0	.985	-.030	-.067
11.5	.986	-.035	-.059
13.5	.979	-.041	-.077
17.5	.962	-.067	-.083
19.0	.971	-.044	-.086
19.5	.965	-.048	-.086
21.5	.966	-.062	-.091
23.6	.939	-.067	-.101
25.4	.965	-.119	-.128
27.0	1.060	-.136	-.128
29.0	1.044	-.119	-.129
29.6	1.040	-.119	-.120
31.0	1.040	-.107	-.125
35.0	1.032	-.107	-.123
39.0	1.020	-.170	-.117
40.0	1.042	-.166	-.090
50.0	1.050	-.169	-.080
60.0	1.032	-.193	-.090
70.6	1.050	-.200	-.035
80.0	1.042	-.203	-.012
90.3	1.056	-.202	.010
100.0	1.053	-.193	.036
110.2	1.056	-.176	.055
120.2	1.045	-.157	.077
130.0	1.036	-.176	.096
140.1	1.041	-.006	.105
150.0	1.017	-.066	.117
160.0	1.037	-.079	.127
170.9	1.016	.020	.126
180.0	1.022	.062	.123
190.9	1.029	.079	.116
200.9	1.015	.110	.101
210.9	1.013	.160	.087
220.0	1.017	.140	.060
230.9	1.026	.196	.057
230.0	1.033	.109	.060
238.9	1.063	.199	.066
240.9	1.030	.196	.063
242.9	1.071	.197	.039
244.0	1.077	.200	.035
249.0	1.030	.206	.023
255.0	1.037	.210	.007
265.0	1.019	.221	-.011
269.0	1.066	.220	-.017
270.0	1.063	.225	-.030
280.1	1.036	.216	-.063
290.0	1.030	.203	-.085
300.2	1.035	.170	-.136
310.0	1.020	.156	-.121
320.2	1.030	.137	-.136
333.2	1.009	.160	-.151
337.2	.973	.122	-.147
339.2	.967	.077	-.131
339.3	.995	.073	-.129
343.0	.986	.056	-.117
345.3	.987	.056	-.110
347.0	1.017	.060	-.103
349.3	.995	.060	-.098
351.3	.987	.030	-.093
353.3	.978	.026	-.087
355.3	.973	.007	-.083
358.0	.969	-.001	-.076
359.3	.972	-.006	-.073
359.3	.976	-.005	-.071

RADIUS = .781

ANGLE	VX/V	VT/V	VR/V
0.0	.956	.000	-.086
1.0	.957	.001	-.091
11.0	.978	-.042	-.100
12.0	.991	-.043	-.100
14.0	.988	-.053	-.100
17.0	.996	-.053	-.111
19.0	.998	-.058	-.116
20.0	.996	-.049	-.118
21.0	1.009	-.067	-.113
23.0	1.010	-.029	-.102
25.0	.965	-.066	-.103
26.0	.963	-.119	-.119
29.0	1.010	-.131	-.131
31.0	1.073	-.111	-.129
32.0	1.030	-.109	-.129
40.9	1.016	-.122	-.116
41.1	1.018	-.173	-.119
51.0	1.026	-.168	-.096
60.9	1.010	-.172	-.076
70.0	1.036	-.167	-.069
80.9	1.005	-.209	-.019
91.1	1.021	-.206	.012
100.0	1.035	-.190	.037
111.2	1.026	-.190	.066
120.0	1.020	-.170	.099
131.0	1.020	-.152	.113
141.1	1.016	-.120	.130
151.3	1.036	-.100	.144
161.2	1.016	-.067	.156
171.0	1.032	-.031	.169
181.3	1.031	.001	.169
191.0	1.030	.032	.163
201.0	1.053	.063	.157
211.6	1.075	.096	.140
221.0	1.049	.110	.133
231.6	1.059	.166	.116
241.0	1.066	.150	.095
251.0	1.061	.175	.070
261.3	1.069	.186	.060
271.3	1.066	.196	.026
281.0	1.075	.199	-.000
291.3	1.066	.198	-.029
301.2	1.069	.166	-.056
311.7	1.067	.159	-.093
319.2	1.067	.136	-.100
323.7	1.068	.176	-.108
327.1	1.057	.176	-.112
330.0	.993	.153	-.122
331.0	1.008	.155	-.121
333.1	.966	.112	-.119
335.1	.992	.067	-.115
337.1	1.019	.073	-.132
341.1	1.026	.077	-.133
343.1	1.019	.076	-.132
345.1	1.012	.067	-.126
349.0	.987	.052	-.119
350.0	.983	.049	-.119
350.0	.989	.041	-.117
352.0	.988	.035	-.110
357.0	.969	.010	-.099
360.0	.956	.000	-.086
361.0	.957	.001	-.091

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
0.0	.966	.036	-.139
1.0	.956	.039	-.162
1.3	.956	.036	-.137
3.6	.938	.022	-.137
5.6	.937	.015	-.130
7.0	.926	.007	-.130
11.6	.973	-.010	-.132
11.5	.909	-.025	-.139
13.6	.919	-.037	-.138
15.5	.909	-.046	-.141
17.5	.915	-.059	-.146
21.0	.937	-.065	-.152
23.5	.969	-.068	-.157
25.6	.966	-.050	-.150
27.5	.975	-.046	-.150
29.0	.993	-.173	-.150
31.6	.976	-.130	-.170
31.6	.990	-.127	-.160
33.0	.999	-.105	-.169
33.0	1.006	-.105	-.170
35.0	1.002	-.106	-.168
37.6	1.013	-.109	-.167
39.0	1.012	-.112	-.159
41.0	1.006	-.110	-.151
51.6	1.022	-.162	-.120
61.6	1.026	-.160	-.101
71.0	1.023	-.180	-.075
81.3	1.030	-.187	-.063
91.3	1.036	-.193	-.016
101.2	1.035	-.187	.016
111.2	1.042	-.177	.061
120.0	1.030	-.160	.070
130.0	1.041	-.139	.096
141.0	1.016	-.119	.116
151.0	1.033	-.091	.130
160.9	1.035	-.062	.141
170.9	1.065	-.032	.167
190.8	1.061	-.000	.150
190.8	1.042	.027	.160
200.0	1.039	.050	.162
210.0	1.039	.086	.131
220.6	1.047	.111	.115
219.0	1.038	.135	.090
230.0	1.030	.136	.099
240.7	1.010	.155	.077
250.6	1.040	.169	.051
260.7	1.051	.170	.026
270.6	1.038	.187	-.003
280.6	1.051	.186	-.020
290.0	1.061	.181	-.056
300.7	1.037	.178	-.083
310.0	1.032	.155	-.109
320.6	1.026	.132	-.136
327.0	1.039	.120	-.151
328.6	1.033	.131	.107
328.0	1.036	.129	.107
329.0	1.035	.127	-.156
330.0	.963	.150	-.160
333.0	.950	.112	-.139
332.0	.938	.106	-.130
335.0	.989	.063	-.130
337.1	1.039	.061	-.156
339.1	1.036	.079	-.160
341.0	1.033	.087	-.160
341.1	1.036	.086	-.170
342.0	1.036	.082	-.170
345.1	1.071	.082	-.170
351.1	1.006	.071	-.157
354.0	1.007	.055	-.153
357.1	.969	.047	-.146
360.0	.966	.036	-.139

TABLE D-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 5

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 5
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	1.089	1.027	1.030	1.023	1.192	1.160	1.123	1.067	1.033	1.029	1.030	1.027	1.023
VTBAR =	-.019	.010	-.002	.003	-.078	-.059	-.038	-.067	.008	.003	-.002	-.001	.003
VRBAR =	.001	-.007	.018	-.009	.039	.027	.013	-.005	-.009	.009	.018	.008	-.009
1-WVX =	1.131	1.081	1.059	1.047	0.000	1.175	1.155	1.118	1.039	1.069	1.058	1.051	1.046
1-WX =	1.186	1.103	1.071	1.055	0.000	1.262	1.221	1.158	1.114	1.086	1.071	1.061	1.054
BBAR =	29.55	20.81	17.24	14.02	43.65	39.06	34.03	2[illegible].72	21.97	19.06	16.85	15.02	13.52
BPOS =	4.24	2.31	1.10	.88	8.33	6.90	5.44	3.53	2.58	1.55	1.03	.82	.83
THETA =	107.50	90.00	100.00	110.00	107.50	107.50	107.50	107.50	90.00	100.00	100.00	100.00	110.00
BNEG =	-4.47	-1.76	-1.85	-1.41	-10.43	-8.22	-5.90	-3.58	-2.13	-1.62	-1.85	-1.68	-1.36
THETA =	340.00	337.50	332.50	332.50	12.50	15.00	340.00	340.00	337.50	332.50	332.50	332.50	332.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE D-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 5

VELOCITY COMPONENT RATIOS TO MODEL 5365 CORRELATION WITH R V ATHENA 5
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0421	.0330	.0285	.0200	.0134	.0070	.0016	.0031
PHASE ANGLE =	264.1	265.5	271.1	256.2	260.1	261.7	254.6	99.6
RADIUS = .633								
AMPLITUDE =	.0157	.0241	.0204	.0055	.0058	.0030	.0026	.0049
PHASE ANGLE =	297.7	260.2	258.8	267.6	241.8	231.0	97.7	86.1
RADIUS = .781								
AMPLITUDE =	.0248	.0185	.0079	.0047	.0059	.0004	.0010	.0013
PHASE ANGLE =	213.0	271.4	280.6	294.7	266.2	66.4	151.9	356.2
RADIUS = .963								
AMPLITUDE =	.0293	.0218	.0156	.0088	.0096	.0095	.0058	.0073
PHASE ANGLE =	249.1	250.2	227.7	192.2	196.2	166.5	157.1	161.4

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0076	.0104	.0113	.0092	.0109	.0057	.0040	.0097
PHASE ANGLE =	114.3	93.7	99.0	111.8	103.5	98.3	79.3	213.1
RADIUS = .633								
AMPLITUDE =	.0042	.0018	.0018	.0022	.0027	.0041	.0038	.0067
PHASE ANGLE =	79.1	91.3	100.0	91.9	29.2	280.7	313.0	267.6
RADIUS = .781								
AMPLITUDE =	.0035	.0011	.0019	.0030	.0042	.0040	.0039	.0038
PHASE ANGLE =	165.0	214.2	11.1	303.4	294.3	221.5	316.7	305.9
RADIUS = .963								
AMPLITUDE =	.0035	.0027	.0039	.0027	.0015	.0015	.0032	.0015
PHASE ANGLE =	146.7	159.8	189.2	256.5	259.7	300.2	289.8	232.2

TABLE D-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 5

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 5
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.1003	.0429	.0456	.0420	.0271	.0121	.0107	.0047
PHASE ANGLE =	240.1	275.7	279.1	256.3	271.4	281.1	263.2	258.6
RADIUS = .350								
AMPLITUDE =	.0810	.0400	.0388	.0353	.0223	.0106	.0079	.0022
PHASE ANGLE =	244.[illegible]	272.9	2[illegible].4	256.1	269.1	276.6	262.7	247.4
RADIUS = .400								
AMPLITUDE =	.0599	.0365	.0309	.0275	.0179	.0087	.0047	.0010
PHASE ANGLE =	252.3	269.2	274.7	256.0	265.4	270.0	261.2	133.4
RADIUS = .500								
AMPLITUDE =	.0323	.0305	.0197	.0151	.0106	.0059	.0004	.0043
PHASE ANGLE =	275.6	263.1	267.7	256.8	255.1	254.6	181.8	94.6
RADIUS = .600								
AMPLITUDE =	.0190	.0256	.0111	.0071	.0086	.0036	.0023	.0052
PHASE ANGLE =	297.8	260.1	260.0	262.6	243.6	237.0	97.5	88.4
RADIUS = .700								
AMPLITUDE =	.0157	.0206	.0081	.0051	.0059	.0010	.0012	.0025
PHASE ANGLE =	232.6	267.7	277.8	291.3	264.0	277.6	102.2	48.5
RADIUS = .800								
AMPLITUDE =	.0263	.0183	.0079	.0044	.0058	.0007	.0013	.0010
PHASE ANGLE =	212.8	271.0	277.5	290.9	263.0	107.7	159.1	344.1
RADIUS = .900								
AMPLITUDE =	.0286	.0190	.0104	.0043	.0064	.0048	.0035	.0029
PHASE ANGLE =	226.6	260.9	215.4	220.8	222.4	158.7	161.7	171.5
RADIUS = 1.000								
AMPLITUDE =	.0293	.0218	.0156	.0088	.0036	.0095	.0058	.0073
PHASE ANGLE =	249.1	250.2	2[illegible].7	192.2	196.2	156.5	157.1	161.4

TABLE D-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 5
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0159	.0221	.0252	.0160	.0235	.0237	.0148	.0133
PHASE ANGLE =	148.3	96.6	94.7	116.6	117.9	107.1	97.5	84.4
RADIUS = .350								
AMPLITUDE =	.0130	.0186	.0210	.0141	.0197	.0180	.0115	.0089
PHASE ANGLE =	141.5	95.9	95.6	115.5	115.1	105.9	95.7	86.1
RADIUS = .400								
AMPLITUDE =	.0099	.0144	.0161	.0117	.0153	.0116	.0075	.0040
PHASE ANGLE =	130.2	95.0	97.1	113.9	110.5	103.5	91.3	91.3
RADIUS = .500								
AMPLITUDE =	.0065	.0076	.0062	.0073	.0060	.0021	.0021	.0031
PHASE ANGLE =	101.1	92.6	100.7	109.6	95.5	85.1	49.3	255.3
RADIUS = .600•								
AMPLITUDE =	.0048	.0029	.0030	.0034	.0033	.0033	.0031	.0064
PHASE ANGLE =	80.4	90.4	103.2	100.1	56.0	287.1	318.7	265.0
RADIUS = .700								
AMPLITUDE =	.0028	.0005	.0018	.0012	.0028	.0036	.0040	.0051
PHASE ANGLE =	125.8	143.9	37.3	337.3	320.0	243.3	317.1	286.5
RADIUS = .800								
AMPLITUDE =	.0037	.0012	.0017	.0033	.0044	.0039	.0039	.0036
PHASE ANGLE =	168.3	213.2	7.4	300.4	291.5	219.4	315.7	308.9
RADIUS = .900								
AMPLITUDE =	.0039	.0019	.0039	.0034	.0034	.0023	.0035	.0018
PHASE ANGLE =	166.1	185.1	204.4	[illegible]	280.0	227.1	304.5	302.5
RADIUS = 1.000								
AMPLITUDE =	.0035	.0027	.0039	.0027	.0015	.0015	.0032	.0015
PHASE ANGLE =	146.7	159.8	189.2	258.5	259.7	300.2	289.8	232.2

TABLE D-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 5

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 5
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2469	.0040	[illegible]	[illegible]	.0021	.0008	.0017	[illegible]
PHASE ANGLE =	178.8	116.1	[illegible]	[illegible]	136.7	87.3	52.0	35.4
RADIUS = .633								
AMPLITUDE =	.2132	.0035	.0029	[illegible]	.0021	.0013	.0017	.0030
PHASE ANGLE =	180.2	189.2	[illegible]	[illegible]	240.5	272.1	291.8	339.0
RADIUS = .781								
AMPLITUDE =	.1966	.0054	.0021	.0022	.0023	.0013	.0016	.0011
PHASE ANGLE =	177.9	130.5	[illegible]	[illegible]	222.8	157.0	349.7	347.1
RADIUS = .963								
AMPLITUDE =	.1877	.0082	.0025	.0022	.0032	.0036	.0022	.0022
PHASE ANGLE =	176.5	132.5	99.1	124.0	116.6	97.3	87.3	99.7

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0078	.0070	.0081	.0073	.0062	.0036	.0023	.0018
PHASE ANGLE =	16.9	9.4	10.1	18.0	.1	9.7	5.0	304.8
RADIUS = .633								
AMPLITUDE =	.0034	.0035	.0020	.0010	.0005	.0014	.0031	.0031
PHASE ANGLE =	341.2	335.8	338.0	[illegible]	110.8	154.6	173.7	171.3
RADIUS = .781								
AMPLITUDE =	.0007	.0005	.0007	.0013	.0021	.0027	.0016	.0009
PHASE ANGLE =	348.8	112.4	114.2	157.0	214.6	196.0	179.8	195.8
RADIUS = .963								
AMPLITUDE =	.0019	.0012	.0018	.0019	.0017	.0013	.0011	.0007
PHASE ANGLE =	101.8	156.8	149.7	[illegible]	186.4	186.6	264.6	294.3

TABLE D-6 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 5

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 5
PROPELLER DIAMETER - 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2862	.0148	.0011	.0060	.0075	.0060	.0077	.0093
PHASE ANGLE =	175.4	86.7	207.8	147.4	113.6	101.1	70.7	72.2
RADIUS = .350								
AMPLITUDE =	.2747	.0112	.0014	.0051	.0057	.0043	.0053	.0076
PHASE ANGLE =	176.4	89.8	231.9	156.7	115.9	99.9	69.3	65.7
RADIUS = .400								
AMPLITUDE =	.2608	.0072	.0029	.0043	.0038	.0024	.0036	.0057
PHASE ANGLE =	177.6	97.1	247.5	171.0	121.4	97.1	65.5	53.9
RADIUS = .500								
AMPLITUDE =	.2371	.0028	.0027	.0034	.0013	.0003	.0008	.0036
PHASE ANGLE =	179.5	145.9	260.8	203.0	167.7	319.0	9.3	18.0
RADIUS = .600								
AMPLITUDE =	.2183	.0033	.0030	.0031	.0018	.0013	.0015	.0031
PHASE ANGLE =	180.3	190.2	268.4	231.8	235.9	277.5	292.3	345.4
RADIUS = .700								
AMPLITUDE =	.2046	.0038	.0028	.0027	.0025	.0009	.0017	.0021
PHASE ANGLE =	179.1	150.1	279.6	269.9	235.4	218.6	320.4	337.0
RADIUS = .800								
AMPLITUDE =	.1951	.0058	.0018	.0020	.0022	.0014	.0016	.0009
PHASE ANGLE =	177.7	128.8	290.6	294.5	217.6	147.5	357.3	355.9
RADIUS = .900								
AMPLITUDE =	.1894	.0075	.0006	.0001	.0018	.0026	.0016	.0012
PHASE ANGLE =	176.8	128.2	70.3	28.0	154.8	112.3	52.2	88.4
RADIUS = 1.000								
AMPLITUDE =	.1877	.0082	.0025	.0022	.0032	.0036	.0022	.0022
PHASE ANGLE =	176.5	132.5	99.1	124.0	116.6	97.3	87.3	90.7

TABLE D-6 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R V ATHENA 5
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0148	.0119	.0170	.0170	.0153	.0101	.012[illegible]	.0111
PHASE ANGLE =	[illegible]	36.4	[illegible]	[illegible]	351.0	356.1	358.4	331.1
RADIUS = .3[illegible]0								
AMPLITUDE =	.012[illegible]	.0103	[illegible]	[illegible]	.0126	.0081	.0041	.0081
PHASE ANGLE =	41.8	30.[illegible]	[illegible]	[illegible]	352.7	256.4	358.[illegible]	32[illegible].2
RADIUS = .400								
AMPLITUDE =	.0101	.0085	[illegible]	.0110	[illegible]	.00[illegible]8	[illegible]	.0047
PHASE ANGLE =	25.6	22.8	[illegible]	[illegible]	[illegible]	2.4	[illegible]	324.3
RADIUS = .500								
AMPLITUDE =	.0144	.0060	[illegible]	[illegible]	.0042	.0022	.00[illegible]1	.0010
PHASE ANGLE =	[illegible]	[illegible]	[illegible]	15.4	5.3	20.9	53.0	226.8
RADIUS = .600								
AMPLITUDE =	.0042	.0041	[illegible]	.0018	.0009	.0010	.0027	.0028
PHASE ANGLE =	[illegible]	340.9	3[illegible]	1.2	43.4	131.0	172.4	173.4
RADIUS = .700								
AMPLITUDE =	.0026	.0014	[illegible]	[illegible]	.0012	.0021	.0024	.0019
PHASE ANGLE =	248.7	244.2	[illegible].3	[illegible]	207.5	185.6	173.9	176.8
RADIUS = .800								
AMPLITUDE =	.0005	.0007	[illegible]	.0015	.0022	.0027	.0014	.0007
PHASE ANGLE =	3.3	126.7	[illegible]	1[illegible]3.4	214.3	197.1	183.0	205.5
RADIUS = .900								
AMPLITUDE =	.0011	.0014	.0016	[illegible]	.0022	.0022	.0009	.0006
PHASE ANGLE =	103.[illegible]	148.1	142.3	1[illegible].2	205.3	196.9	227.9	280.1
RADIUS = 1.000								
AMPLITUDE =	.0019	.0012	.0018	.0019	.0017	.0013	.0011	.0007
PHASE ANGLE =	1[illegible]1.6	156.8	149.7	161.2	186.4	186.6	264.6	294.3

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APPENDIX E

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

FOR EXPERIMENT 6

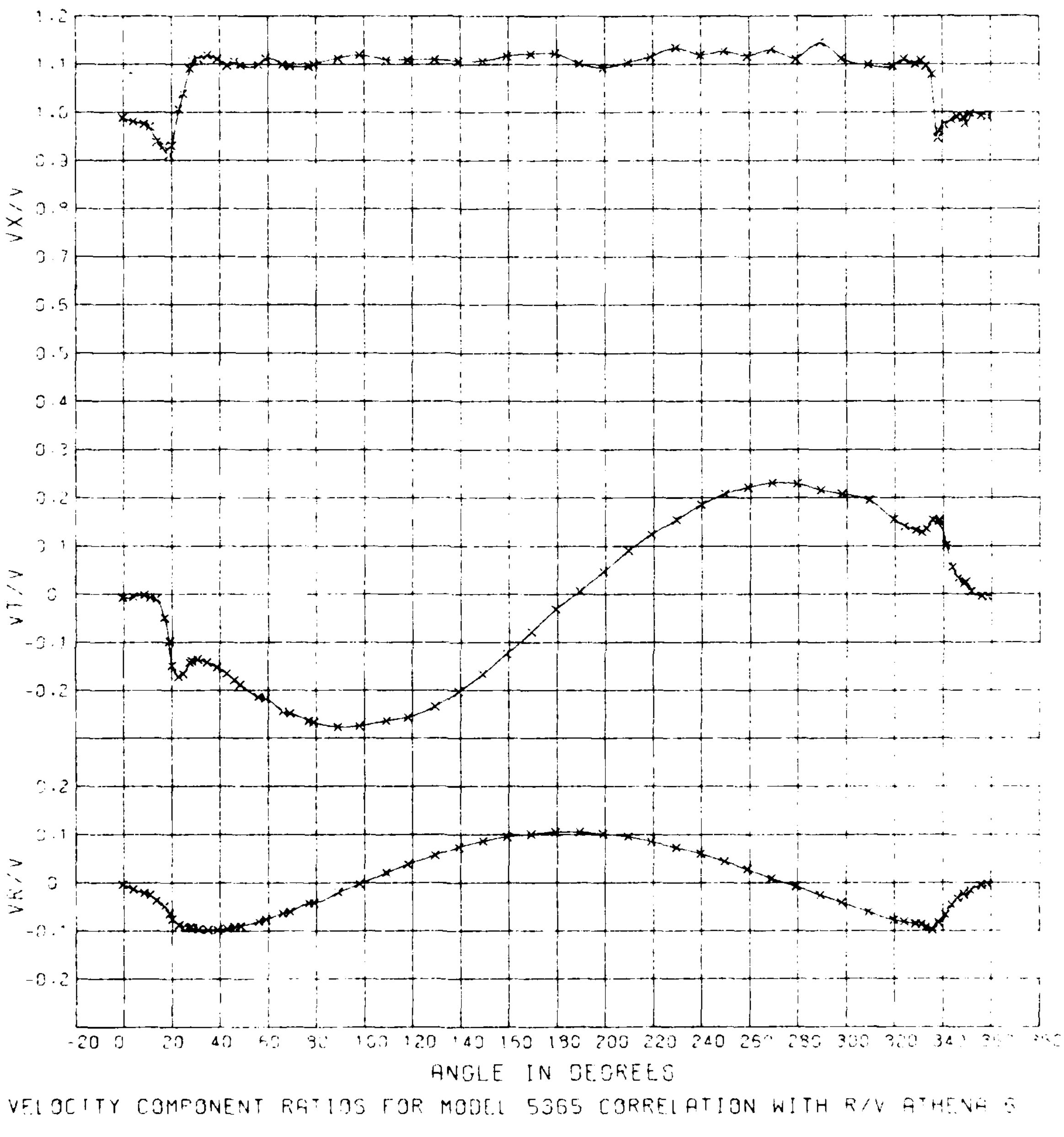
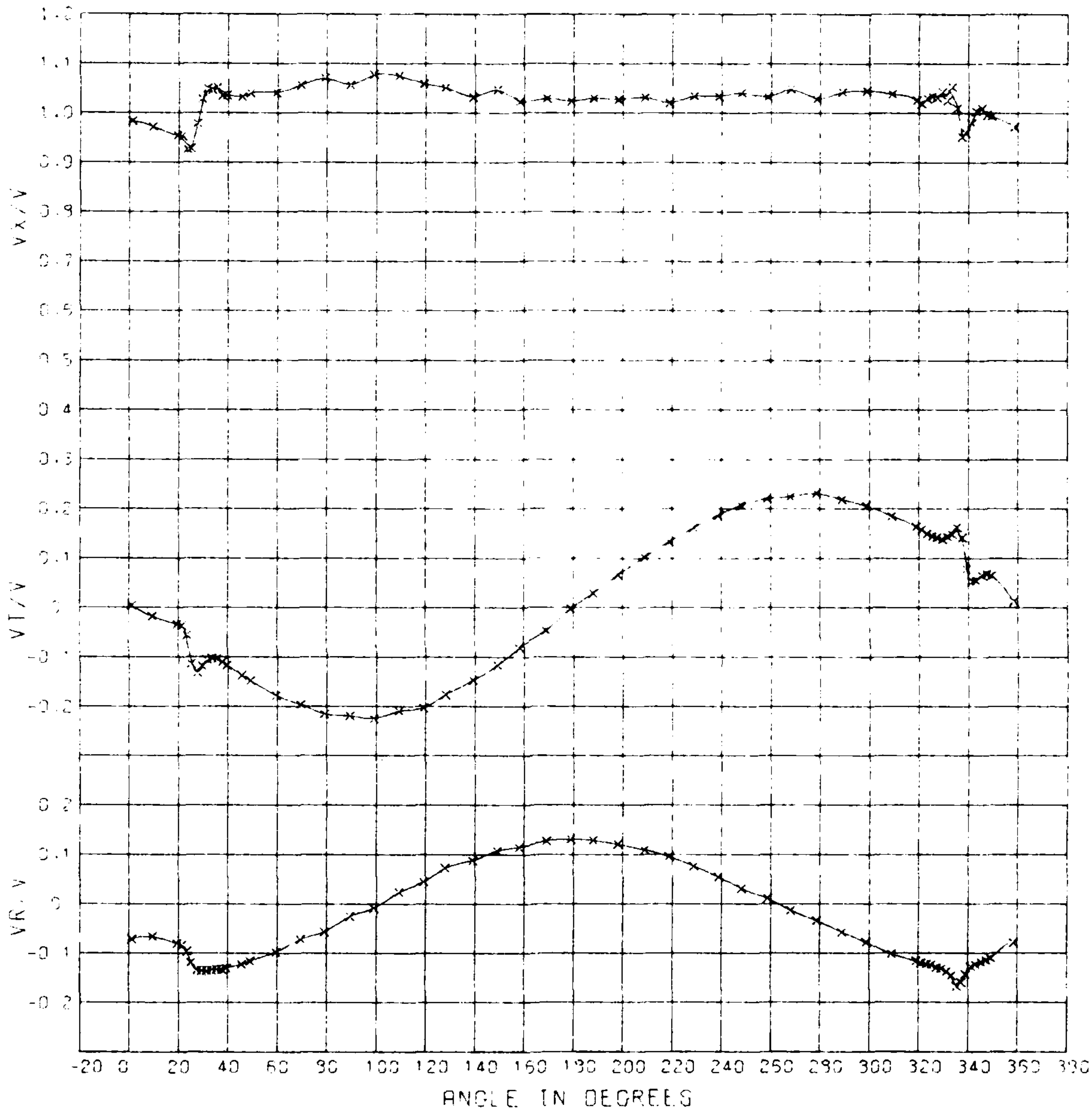


Figure E-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 6



VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA S

0. .AD.

Figure E-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 6

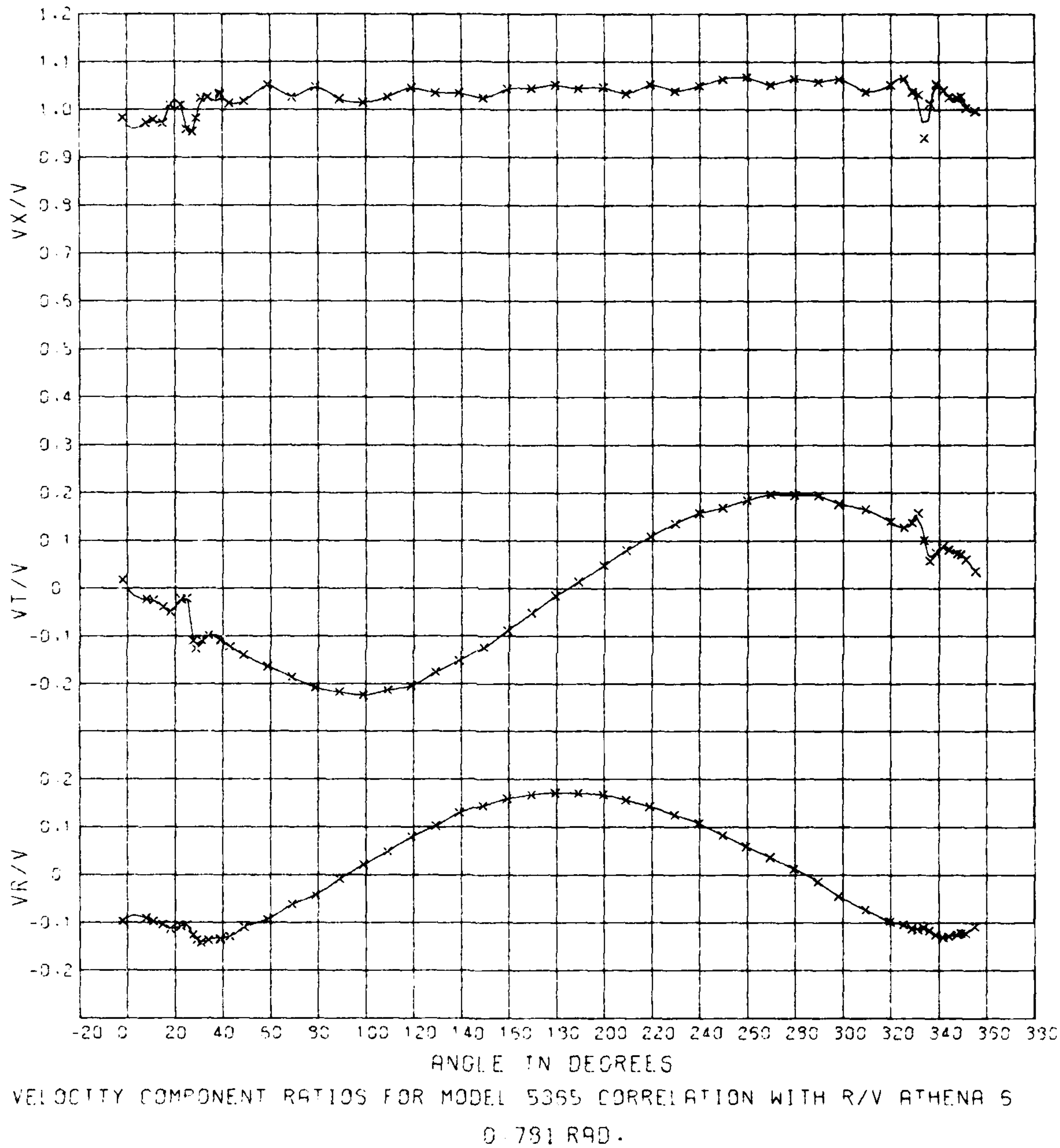


Figure E-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 6

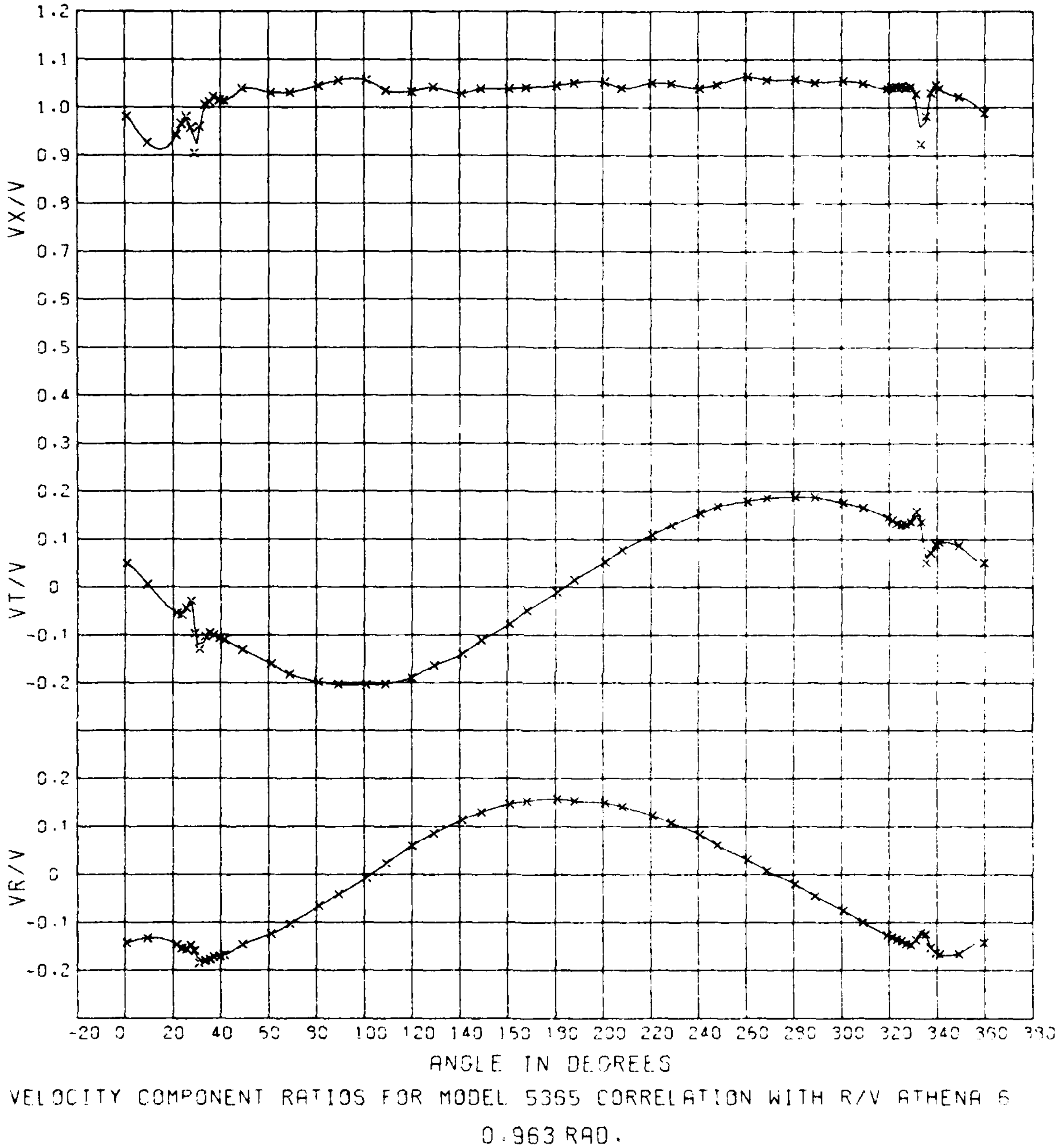


Figure E-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 6

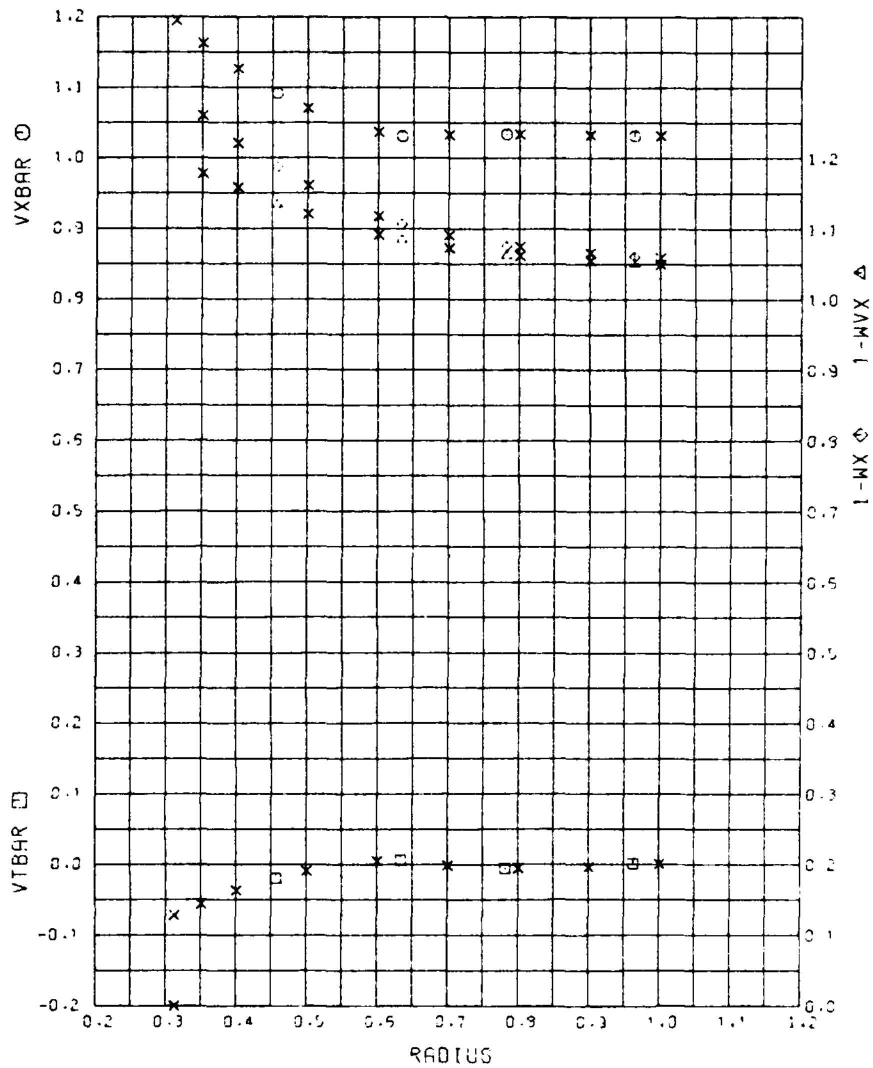


Figure E-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 6

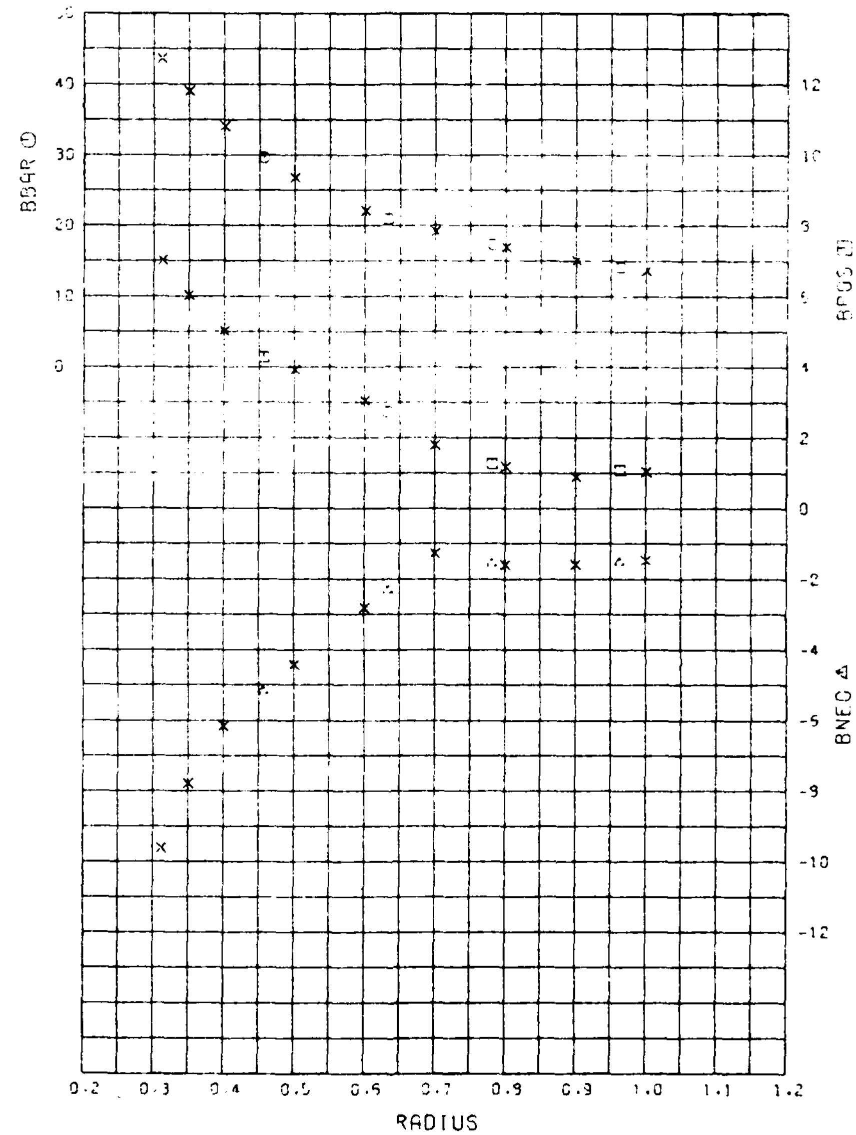


Figure E-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 6

TABLE E-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 6

RADIUS = .456

ANGLE	VX/V	VT/V	VR/V
-1.0	.995	-.011	-.006
0.0	.993	-.006	-.005
4.0	.981	-.005	-.014
8.0	.978	-.007	-.025
9.0	.973	-.002	-.019
11.0	.970	-.008	-.025
13.0	.961	-.006	-.035
14.0	.935	-.013	-.040
16.9	.930	-.050	-.049
18.9	.907	-.091	-.064
19.0	.914	-.105	-.066
20.0	.951	-.150	-.076
22.9	1.007	-.173	-.089
24.8	1.039	-.166	-.093
26.9	1.082	-.165	-.092
28.0	1.100	-.160	-.095
28.0	1.109	-.158	-.096
28.9	1.104	-.161	-.095
30.9	1.110	-.136	-.097
34.8	1.119	-.142	-.098
38.9	1.110	-.153	-.098
42.9	1.097	-.156	-.096
46.0	1.105	-.179	-.092
48.0	1.095	-.190	-.090
49.0	1.101	-.187	-.090
56.0	1.098	-.215	-.081
58.9	1.112	-.217	-.077
66.0	1.099	-.245	-.066
69.0	1.096	-.249	-.061
76.8	1.096	-.263	-.047
78.8	1.107	-.265	-.047
79.0	1.093	-.269	-.043
89.0	1.112	-.277	-.020
99.0	1.119	-.275	-.133
109.1	1.109	-.256	.021
109.1	1.104	-.272	.019
118.8	1.104	-.257	.038
129.2	1.110	-.236	.052
139.2	1.104	-.207	.074
149.2	1.101	-.188	.087
149.7	1.112	-.165	.086
159.1	1.117	-.127	.095
169.0	1.119	-.077	.099
169.3	1.121	-.079	.101
179.3	1.121	-.031	.105
189.3	1.101	.005	.105
199.0	1.097	.047	.101
209.4	1.103	.090	.096
219.0	1.115	.126	.085
229.4	1.116	.156	.073
239.5	1.119	.186	.068
249.6	1.127	.208	.044
259.0	1.116	.221	.027
269.0	1.130	.230	.010
279.3	1.110	.229	-.008
289.2	1.146	.215	-.026
298.0	1.117	.208	-.042
309.2	1.099	.195	-.067
319.1	1.088	.158	-.076
320.0	1.103	.156	-.079
329.0	1.111	.141	-.087
329.0	1.097	.136	-.088
329.1	1.103	.132	-.086
331.1	1.104	.126	-.087
331.1	1.109	.129	-.097
333.0	1.096	.136	-.092
335.8	1.093	.149	-.098
335.0	1.066	.148	-.099
338.0	.968	.153	-.085
339.0	.963	.159	-.080
339.0	.957	.159	-.088
339.0	.966	.164	-.086
341.0	.971	.101	-.068
343.0	.971	.087	-.053
344.0	.997	.044	-.048
346.0	.990	.033	-.032
348.0	.997	.074	-.021
349.0	.987	.071	-.023
349.1	.976	.075	-.029
350.7	1.006	.008	-.019
352.0	.989	.002	-.013
355.0	.993	-.005	-.006
356.0	.993	-.003	-.006
359.0	.986	-.003	-.101
359.0	.995	-.011	-.106
360.0	.993	-.004	-.105

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
1.1	.983	.003	-.073
9.5	.971	-.018	-.067
19.6	.954	-.036	-.081
21.4	.960	-.039	-.083
21.5	.965	-.035	-.085
23.5	.976	-.057	-.097
25.0	.978	-.114	-.120
27.5	.978	-.133	-.136
29.4	1.060	-.118	-.136
29.5	1.016	-.120	-.139
31.5	1.049	-.106	-.137
33.5	1.045	-.103	-.136
35.5	1.051	-.105	-.136
37.5	1.034	-.110	-.131
39.4	1.076	-.170	-.133
39.5	1.064	-.114	-.129
45.5	1.032	-.137	-.123
49.0	1.060	-.164	-.116
49.5	1.041	-.179	-.098
69.4	1.056	-.196	-.072
79.0	1.071	-.216	-.057
89.1	1.056	-.219	-.025
99.0	1.078	-.226	-.009
109.7	1.075	-.209	.026
119.2	1.059	-.203	.045
128.8	1.051	-.176	.073
139.1	1.037	-.168	.088
149.0	1.048	-.116	.107
158.0	1.022	-.081	.116
169.0	1.079	-.067	.127
174.9	1.073	-.003	.131
184.0	1.079	.029	.128
194.0	1.077	.067	.121
204.8	1.031	.102	.109
214.7	1.020	.133	.096
224.8	1.034	.162	.076
234.7	1.033	.187	.055
244.0	1.041	.207	.031
254.6	1.037	.221	.011
264.0	1.048	.226	-.013
274.6	1.029	.231	-.036
284.9	1.042	.219	-.058
294.7	1.045	.206	-.078
309.0	1.034	.185	-.102
319.8	1.021	.165	-.117
319.7	1.030	.162	-.115
321.0	1.014	.159	-.120
323.2	1.029	.158	-.123
325.2	1.033	.165	-.126
327.0	1.022	.162	-.133
327.1	1.061	.142	-.128
329.3	1.017	.140	-.137
329.3	1.047	.136	-.137
331.3	1.125	.146	-.139
333.3	1.053	.150	-.145
333.3	1.051	.168	-.147
335.3	1.010	.163	-.168
337.3	.957	.142	-.160
339.0	.959	.078	-.166
341.1	.950	.055	-.129
341.0	1.003	.055	-.126
345.4	1.010	.065	-.119
347.6	.996	.068	-.115
349.1	.995	.065	-.109
349.6	.992	.044	-.113
354.0	.971	.016	-.079
359.0	.969	.009	-.091

RADIUS = .781

ANGLE	VX/V	VT/V	VR/V
-2.0	.983	.018	-.098
4.0	.971	-.022	-.091
10.9	.979	-.026	-.098
14.9	.971	-.039	-.106
19.0	1.027	-.050	-.116
14.8	.993	-.051	-.116
22.0	1.008	-.026	-.108
22.9	1.012	-.072	-.107
24.9	.959	-.021	-.105
25.9	.910	-.091	-.171
28.0	.996	-.129	-.133
29.9	.982	-.177	-.138
30.9	1.026	-.189	-.143
36.0	1.026	-.098	-.138
38.9	1.039	-.106	-.133
38.9	1.079	-.107	-.140
39.9	1.030	-.109	-.136
42.9	1.013	-.122	-.130
49.0	1.017	-.140	-.110
58.9	1.052	-.166	-.096
69.0	1.075	-.187	-.062
78.8	1.069	-.208	-.043
89.0	1.071	-.218	-.009
98.9	1.014	-.225	.021
109.1	1.026	-.214	.049
119.0	1.045	-.205	.079
129.2	1.036	-.176	.103
139.1	1.035	-.152	.130
149.2	1.023	-.126	.146
159.2	1.043	-.098	.159
169.3	1.044	-.052	.167
179.3	1.051	-.016	.171
199.0	1.044	.016	.170
199.6	1.347	.049	.168
209.0	1.032	.081	.156
219.0	1.057	.109	.143
229.6	1.039	.137	.125
239.5	1.049	.158	.107
249.6	1.066	.169	.082
259.6	1.068	.185	.060
269.3	1.051	.196	.036
279.3	1.065	.196	.017
289.3	1.056	.193	-.015
299.3	1.059	.195	-.016
298.0	1.066	.177	-.065
309.2	1.037	.166	-.073
319.1	1.050	.161	-.095
320.0	1.051	.139	-.100
325.1	1.065	.129	-.106
328.0	1.035	.136	-.116
329.1	1.040	.139	-.112
331.1	1.031	.158	-.115
333.1	.930	.143	-.112
336.0	.950	.050	-.111
339.0	1.012	.057	-.116
339.0	1.057	.076	-.125
339.0	1.056	.076	-.127
341.0	1.044	.087	-.131
347.0	1.037	.088	-.132
346.0	1.076	.091	-.129
346.9	1.033	.078	-.126
348.0	1.015	.068	-.126
349.0	1.027	.071	-.127
351.0	1.003	.061	-.123
354.9	.997	.036	-.108
358.0	.983	.018	-.098

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
0.0	.986	.047	-.139
1.3	.975	.051	-.148
9.6	.976	.006	-.134
21.5	.961	-.054	-.147
23.5	.965	-.057	-.156
25.5	.981	-.063	-.158
27.5	.957	-.079	-.168
29.0	.986	-.097	-.159
29.0	.984	-.097	-.160
31.0	.968	-.129	-.185
33.5	1.066	-.183	-.180
35.6	1.011	-.095	-.170
37.0	1.072	-.100	-.173
39.5	1.015	-.106	-.171
41.4	1.013	-.118	-.168
49.0	1.048	-.131	-.147
61.0	1.079	-.161	-.125
69.0	1.031	-.182	-.103
81.0	1.043	-.197	-.066
91.0	1.046	-.199	-.068
89.3	1.056	-.203	-.042
101.0	1.057	-.205	-.007
109.2	1.035	-.202	.025
120.0	1.033	-.190	.060
129.1	1.042	-.166	.085
141.0	1.028	-.140	.113
149.0	1.038	-.111	.129
160.9	1.038	-.078	.146
168.0	1.040	-.049	.152
180.9	1.046	-.011	.157
198.0	1.047	.015	.156
180.0	1.056	.014	.152
200.7	1.054	.053	.149
208.0	1.039	.078	.141
220.6	1.052	.109	.123
228.7	1.049	.129	.108
240.6	1.048	.155	.086
248.0	1.047	.168	.061
260.6	1.065	.179	.031
268.9	1.057	.186	.008
280.6	1.058	.188	-.020
288.9	1.051	.188	-.045
300.7	1.056	.176	-.075
309.0	1.050	.166	-.099
319.2	1.040	.166	-.127
321.2	1.041	.140	-.132
323.2	1.043	.133	-.136
325.2	1.044	.130	-.130
327.0	1.040	.129	-.148
329.0	1.042	.135	-.148
331.3	1.027	.158	-.137
333.3	.923	.137	-.171
335.3	.982	.052	-.175
337.3	1.031	.071	-.159
339.6	1.067	.090	-.166
348.9	1.037	.092	-.169
341.0	1.041	.093	-.165
349.1	1.072	.086	-.167
359.1	.989	.055	-.167
360.0	.986	.047	-.139
361.3	.975	.051	-.148

TABLE E-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 6

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 6
PROPELLER DIAMETER = 6.00 FEET   JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	1.092	1.031	1.034	1.032	1.195	1.163	1.127	1.071	1.037	1.033	1.034	1.033	1.032
VTBAR =	-.020	.006	-.005	.001	-.072	-.056	-.037	-.009	.005	-.001	-.005	-.004	.001
VRBAR =	.005	-.009	.017	-.010	.055	.039	.021	-.003	-.010	.008	.017	.007	-.010
1-WVX =	1.134	1.085	1.062	1.051	0.000	1.178	1.158	1.121	1.092	1.073	1.062	1.055	1.050
1-WX =	1.187	1.107	1.076	1.061	0.000	1.260	1.221	1.161	1.118	1.091	1.075	1.066	1.059
BBAR =	29.65	20.91	17.31	14.14	43.61	39.07	34.10	2[illegible].82	22.08	19.14	16.93	15.12	13.64
BPOS =	4.28	2.71	1.27	1.10	7.01	6.03	5.02	3.92	3.05	1.79	1.18	.90	1.04
THETA =	97.50	100.00	80.00	95.00	90.00	90.00	90.00	100.00	100.00	80.00	80.00	80.00	95.00
BNEG =	-5.17	-2.32	-1.56	-1.52	-9.[illegible]1	-7.79	-6.17	-[illegible].42	-2.82	-1.28	-1.60	-1.59	-1.47
THETA =	337.50	337.50	352.50	15.00	340.00	340.00	337.50	337.50	337.50	335.00	332.50	332.50	15.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE E-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 6

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R.V ATHENA 6
PROPELLER DIAMETER 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	[illegible]	.0362	[illegible]	[illegible]	.0135	.0105	.0043	.0062
PHASE ANGLE =	[illegible]	267.7	[illegible]	[illegible]	272.2	205.9	229.4	109.7
RADIUS = .633								
AMPLITUDE =	.0180	.0281	[illegible]	[illegible]	.0058	.0033	[illegible]	.0025
PHASE ANGLE =	360.3	257.6	[illegible]	[illegible]	242.1	176.0	135.1	121.4
RADIUS = .781								
AMPLITUDE =	[illegible]	.0153	[illegible]	[illegible]	[illegible]	.0020	.0034	.0048
PHASE ANGLE =	[illegible]	255.7	[illegible]	[illegible]	[illegible]	96.3	272.3	210.3
RADIUS = .963								
AMPLITUDE =	[illegible]	.0238	.0179	[illegible]	[illegible]	[illegible]	.0097	.0079
PHASE ANGLE =	244.6	250.4	229.9	[illegible]	[illegible]	179.9	146.8	124.9

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R V ATHENA 6
PROPELLER DIAMETER 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	[illegible]	.0115	[illegible]	[illegible]	.0041	.0025	.0021	.0018
PHASE ANGLE =	[illegible]	94.6	[illegible]	[illegible]	68.6	38.2	319.7	269.5
RADIUS = .633								
AMPLITUDE =	[illegible]	.0059	[illegible]	[illegible]	.0010	.0011	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	68.3	[illegible]	[illegible]	301.5	274.5	308.5	258.7
RADIUS = .781								
AMPLITUDE =	.0002	.0004	[illegible]	[illegible]	.0015	.0050	.0054	.0031
PHASE ANGLE =	4.5	167.2	[illegible]	[illegible]	238.0	272.9	279.1	272.3
RADIUS = .963								
AMPLITUDE =	[illegible]	.0018	.0049	[illegible]	.0014	.0016	.0018	.0013
PHASE ANGLE =	[illegible]	191.0	151.2	[illegible]	216.4	176.9	325.2	319.0

TABLE E-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY *COMPONENT* RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 6

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 6
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.0951	.0389	.0558	.0363	.0258	.0196	.0208	.0098
PHASE ANGLE =	234.9	282.1	[illegible]	[illegible]	277.1	213.1	274.9	129.2
RADIUS = .350								
AMPLITUDE =	.0766	.0383	.0454	.0304	.0221	.0170	.0150	.0087
PHASE ANGLE =	[illegible]	277.7	292.4	255.6	276.5	211.7	270.9	123.6
RADIUS = .400								
AMPLITUDE =	.0564	.0375	[illegible]	.0237	.0177	.0137	.0089	.0075
PHASE ANGLE =	247.6	272.6	[illegible]	267.2	275.0	209.4	260.7	116.5
RADIUS = .500								
AMPLITUDE =	.0310	.0348	.0163	.0131	.0108	.0083	.0035	.0053
PHASE ANGLE =	273.5	264.5	[illegible]	260.3	268.4	202.1	181.1	106.0
RADIUS = .600								
AMPLITUDE =	.0205	.0302	.0125	.0066	.0065	.0043	.0051	.0031
PHASE ANGLE =	248.7	258 9	244.6	258.0	251.0	186.0	137.5	110.1
RADIUS = .700								
AMPLITUDE =	.0155	.0202	.0106	.0057	.0058	.0016	.0014	.0031
PHASE ANGLE =	252.5	257.4	253.9	232.5	228.2	121.8	240.0	203.8
RADIUS = .800								
AMPLITUDE =	.0229	.0150	.0119	[illegible]	.0066	.0020	.0034	.0049
PHASE ANGLE =	[illegible]	255.0	264.3	[illegible]	210.9	102.2	268.8	207.2
RADIUS = .900								
AMPLITUDE =	.0261	.0179	.0142	.0077	.0080	.0040	.0037	.0051
PHASE ANGLE =	[illegible]	251.5	246.9	197.3	199.7	162.5	177.4	161.6
RADIUS = 1.000								
AMPLITUDE =	.0265	.0238	.0179	.0081	.0091	.0080	.0097	.0079
PHASE ANGLE =	244.6	250.4	223.9	189.6	195.2	179.9	146.8	124.9

TABLE E-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 6
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0086	.0182	.0295	.0158	.0112	.0052	.0015	.0056
PHASE ANGLE =	36.7	117.6	131.7	113.7	80.4	22.1	230.7	62.3
RADIUS = .350								
AMPLITUDE =	.0075	.0161	.0239	.0133	.0090	.0044	.0011	.0033
PHASE ANGLE =	50.2	111.9	125.5	108.7	78.4	26.9	263.8	57.9
RADIUS = .400								
AMPLITUDE =	.0067	.0137	.0178	.0114	.0065	.0035	.0014	.0009
PHASE ANGLE =	68.7	103.9	114.9	101.5	74.9	33.0	304.6	24.1
RADIUS = .500								
AMPLITUDE =	.0064	.0100	.0132	.0075	[illegible]	.0018	.0025	.0032
PHASE ANGLE =	97.5	87.3	83.8	[illegible]	54.7	39.5	321.7	261.1
RADIUS = .600								
AMPLITUDE =	.0057	.0069	.0046	[illegible]	.0008	.0006	.0034	.0049
PHASE ANGLE =	112.8	72.3	50.6	71.7	337.3	320.7	313.6	258.3
RADIUS = .700								
AMPLITUDE =	.0020	.0026	.0008	[illegible]	.0011	.0038	.0048	.0041
PHASE ANGLE =	166.2	71.5	171.8	[illegible]	260.3	[illegible]	287.0	263.9
RADIUS = .800								
AMPLITUDE =	.0003	.0007	.0053	.0012	.0016	.0050	.0053	.0028
PHASE ANGLE =	319.4	202.0	202.4	[illegible]	[illegible]	271.8	278.6	274.8
RADIUS = .900								
AMPLITUDE =	.0011	.0018	.0056	[illegible]	[illegible]	.0030	.0036	.0018
PHASE ANGLE =	175.5	212.0	185.0	[illegible]	223.2	256.2	265.9	294.7
RADIUS = 1.000								
AMPLITUDE =	.0033	.0018	.0049	.0018	.0014	.0016	.0016	.0013
PHASE ANGLE =	153.7	191.0	151.2	229.5	216.4	176.9	325.2	319.0

TABLE E-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 6

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R V ATHENA 6
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2533	.0034	.0037	.0028	.0023	.0008	.0036	.0042
PHASE ANGLE =	[illegible]	99.8	[illegible]	177.5	236.1	112.0	29.6	9.3
RADIUS = .633								
AMPLITUDE =	.2234	.0029	.0028	[illegible]	.0016	.0009	.0013	.0030
PHASE ANGLE =	176.9	105.4	[illegible]	[illegible]	222.8	306.2	330.9	347.1
RADIUS = .781								
AMPLITUDE =	.2051	.0065	.0044	.0025	.0014	.0012	.0023	.0007
PHASE ANGLE =	174.6	78.0	[illegible]	225.3	183.7	233.1	287.9	272.7
RADIUS = .963								
AMPLITUDE =	[illegible]	.0107	.0006	.0028	.0027	.0027	.0026	.0021
PHASE ANGLE =	173.1	96.2	128.6	132.3	[illegible]	101.4	97.9	74.5

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R V ATHENA 6
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0060	.0072	.0094	.0082	.0061	.0042	.0022	.0017
PHASE ANGLE =	355.4	356.8	348.8	352.3	349.9	341.4	305.8	233.0
RADIUS = .633								
AMPLITUDE =	.0029	.0024	.0026	.0015	.0013	.0023	.0040	.0043
PHASE ANGLE =	343.3	351.8	327.9	[illegible]	204.6	180.9	193.9	168.3
RADIUS = .781								
AMPLITUDE =	.0014	.0022	.0017	.0029	.0032	.0025	.0031	.0024
PHASE ANGLE =	252.3	221.2	216.8	265.0	203.4	194.5	193.2	184.5
RADIUS = .963								
AMPLITUDE =	.0015	.0010	.0013	.0012	.0016	.0014	.0005	.0006
PHASE ANGLE =	49.0	139.2	151.2	151.7	173.0	161.7	166.3	240.4

TABLE E-6 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 6

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R V ATHENA 6
PROPELLER DIAMETER = 6.90 FEET
JA = .73[illegible]

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.284[illegible]	.0080	.007[illegible]	[illegible]	.00[illegible]	.0042	.007	.0044
PHASE ANGLE =	1[illegible]2.6	77.3	[illegible]	[illegible]	23[illegible]	13[illegible].5	[illegible]	39.8
RADIUS = [illegible]								
AMPLITUDE =	.275[illegible]	.0064	.0063	[illegible]	.00[illegible]	.0031	.0012	.0043
PHASE ANGLE =	[illegible]3.6	81.4	219.5	[illegible]	23[illegible].1	131.0	[illegible].5	30.1
RADIUS = .400								
AMPLITUDE =	.2647	.0047	[illegible]	[illegible]	[illegible]	.0019	[illegible]	.0043
PHASE ANGLE =	1[illegible]4.7	88.[illegible]	22[illegible]	[illegible]	[illegible]	125.8	33.7	1[illegible].1
RADIUS = .500								
AMPLITUDE =	.2451	.0029	[illegible]	.0025	.00[illegible]	.0003	.0027	.0040
PHASE ANGLE =	1[illegible].3	106.3	2[illegible].0	1[illegible].0	2[illegible].1	[illegible].9	24.2	2.9
RADIUS = .600								
AMPLITUDE =	[illegible]	.0025	[illegible]	[illegible]	.00[illegible]	.[illegible]08	.0014	.0033
PHASE ANGLE =	177.0	111.1	2[illegible].5	[illegible]	227.[illegible]	[illegible]5.3	[illegible]	3[illegible]1.0
RADIUS = .700								
AMPLITUDE =	[illegible]138	.0045	[illegible]	[illegible]	.00[illegible]6	.0012	.0022	.0015
PHASE ANGLE =	17[illegible].8	81.5	2[illegible].4	224.[illegible]	2[illegible]	[illegible].9	2[illegible]7.3	323.7
RADIUS = .800								
AMPLITUDE =	[illegible]	.0070	[illegible]043	[illegible]	[illegible]	[illegible]	[illegible]	.0005
PHASE ANGLE =	[illegible]	78.7	2[illegible]	[illegible]	[illegible]	[illegible].4	[illegible]	2[illegible].5
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	.0092	[illegible]020	[illegible]	[illegible]	.0012	[illegible]	.0008
PHASE ANGLE =	[illegible]	97.8	2[illegible].9	17[illegible]	12[illegible]	1[illegible].9	[illegible]	[illegible].7
RADIUS = 1.00[illegible]								
AMPLITUDE =	[illegible]	.0107	.0096	[illegible]	[illegible]	.0027	[illegible]	.00[illegible]
PHASE ANGLE =	1[illegible].1	96.2	12[illegible].6	[illegible]	[illegible]	101.4	[illegible]	7[illegible]

TABLE E-6 (Continued)

VELOCITY COMPONENT RATIOS FOR [illegible] TRANSLATION WITH [illegible] = [illegible] NA 6
PROPELLER DIAMETER = [illegible].30 FEET [illegible]

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS [illegible]

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .3[illegible]2								
AMPLITUDE =	.[illegible]042	.0113	[illegible]	[illegible]	[illegible]	.0146	[illegible]	.0045
PHASE ANGLE =	[illegible]	351.9	3[illegible]	[illegible]	[illegible]	344.1	[illegible]	[illegible]4.9
RADIUS = .3[illegible]0								
AMPLITUDE =	[illegible]	.010[illegible]	[illegible]	[illegible]	[illegible]	.0114	.00[illegible]	.00[illegible]9
PHASE ANGLE =	[illegible]	353.4	3[illegible]	[illegible]	[illegible]	344.0	[illegible]	[illegible].7
RADIUS = .400								
AMPLITUDE =	[illegible]	.00[illegible]	[illegible]	[illegible]	[illegible]	.0077	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	[illegible]	3[illegible]	[illegible]	[illegible]	3[illegible].4	[illegible]	[illegible].4
RADIUS = .500								
AMPLITUDE =	[illegible]	.00[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	357.7	[illegible]	[illegible]	[illegible]	[illegible].5	[illegible]	[illegible]
RADIUS = .[illegible]0								
AMPLITUDE =	[illegible]	.0033	[illegible]	[illegible]	[illegible]	.0017	[illegible]	.0042
PHASE ANGLE =	[illegible]	355.9	3[illegible].6	[illegible]	245.[illegible]	[illegible]	197.[illegible]	[illegible].6
RADIUS = .[illegible]								
AMPLITUDE =	.001[illegible]	.0012	[illegible]	[illegible]	.002[illegible]	.0025	[illegible]	.0034
PHASE ANGLE =	307.0	2[illegible].5	2[illegible].9	[illegible]	205.[illegible]	[illegible].6	[illegible]	174.9
RADIUS = .800								
AMPLITUDE =	[illegible]	.0024	.0018	[illegible]	.003[illegible]	.0024	.002[illegible]	.0022
PHASE ANGLE =	[illegible]	217.2	211.2	[illegible]	202.[illegible]	[illegible].4	192.[illegible]	187.1
RADIUS = .[illegible]00								
AMPLITUDE =	.00[illegible]	.0019	.0017	[illegible]	[illegible]	.0019	.0016	.0011
PHASE ANGLE =	227.2	196.3	[illegible].5	187.2	[illegible]	184.8	[illegible]	207.1
RADIUS = 1.000								
AMPLITUDE =	[illegible]15	.0010	.0013	.0012	.001[illegible]	.0014	[illegible]	.0006
PHASE ANGLE =	[illegible].0	139.2	151.2	151.7	1[illegible]3.[illegible]	161.7	166.[illegible]	240.4

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APPENDIX F

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

FOR EXPERIMENT 8

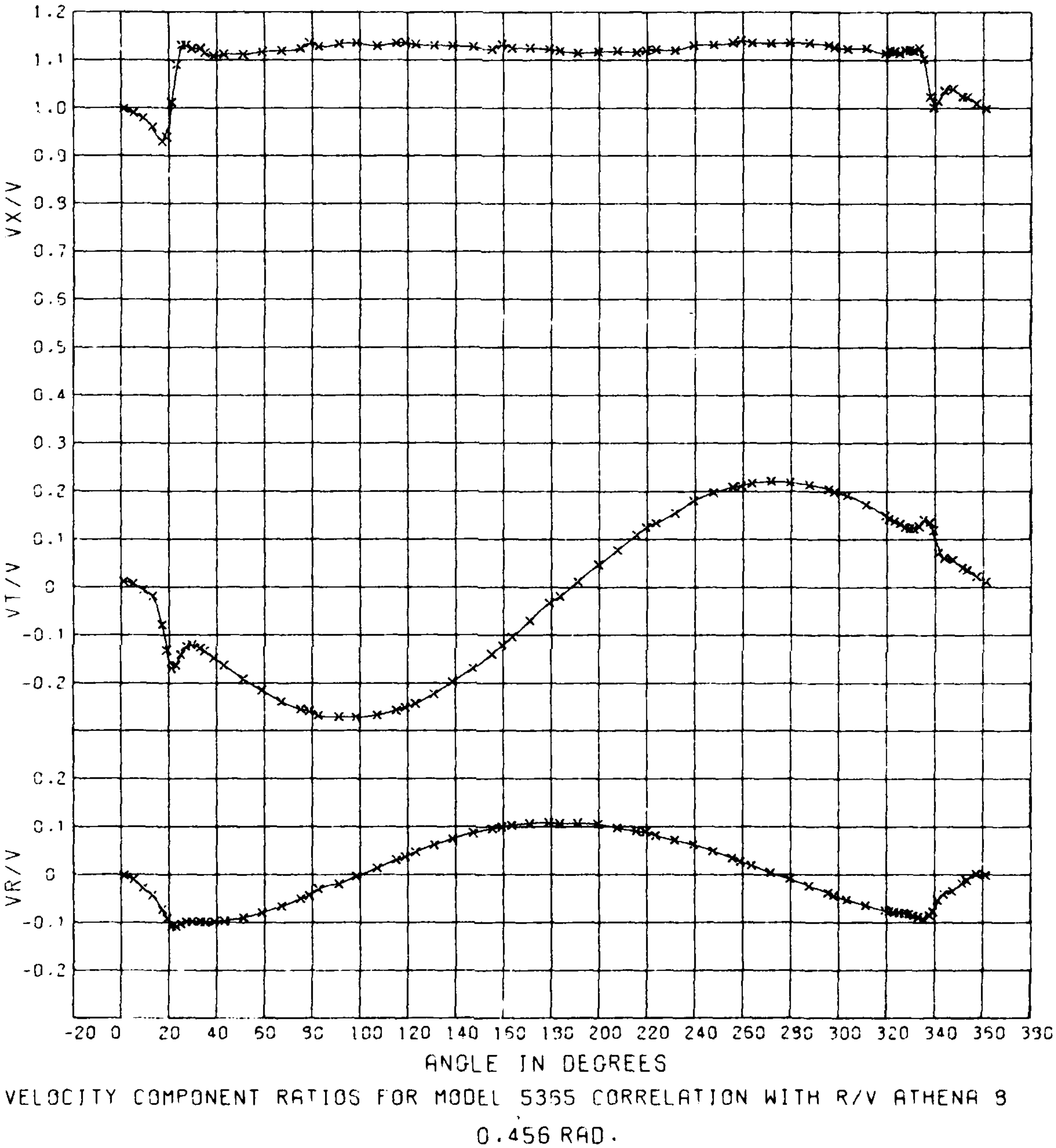

Figure F-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 8

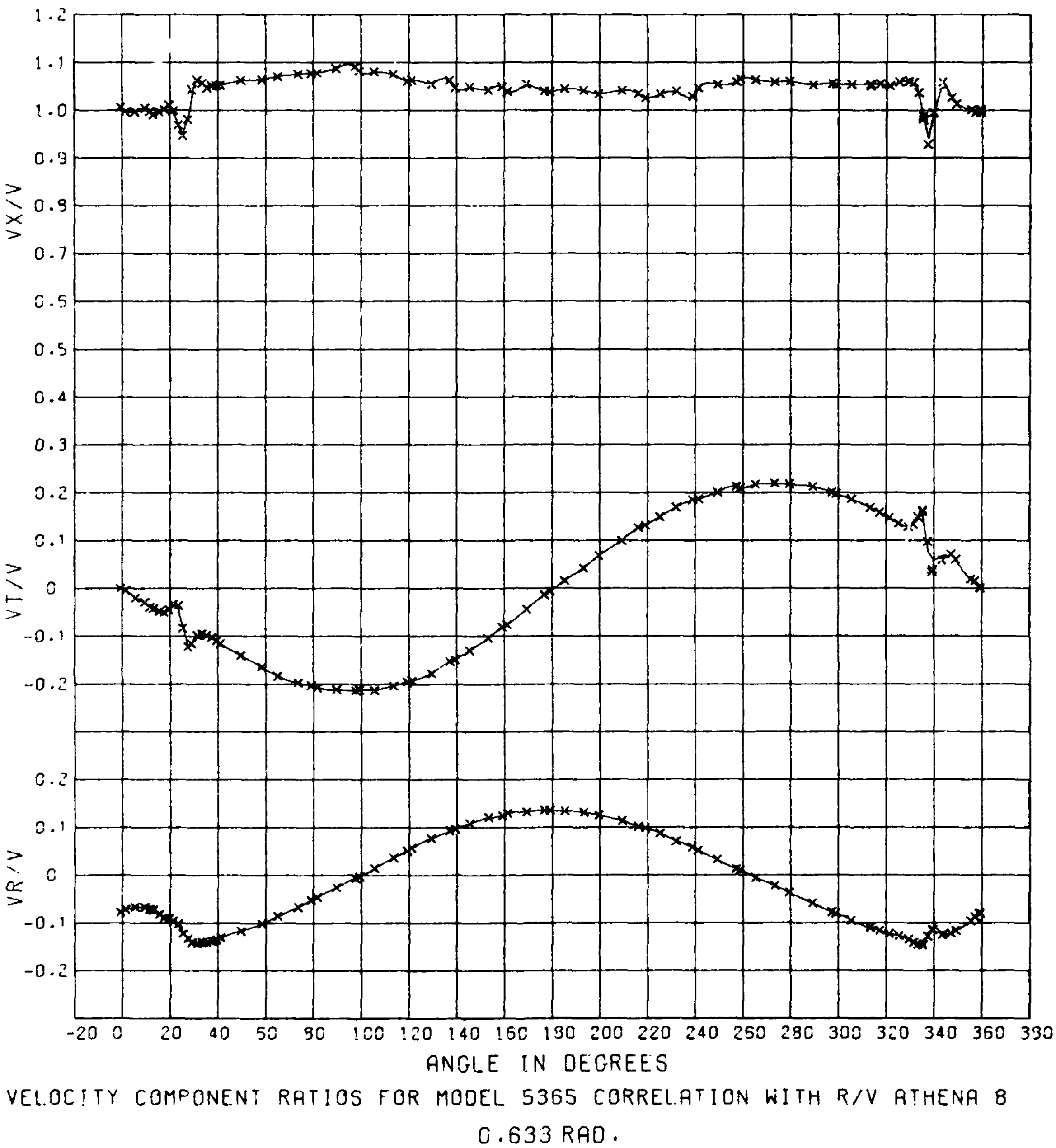

Figure F-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 8

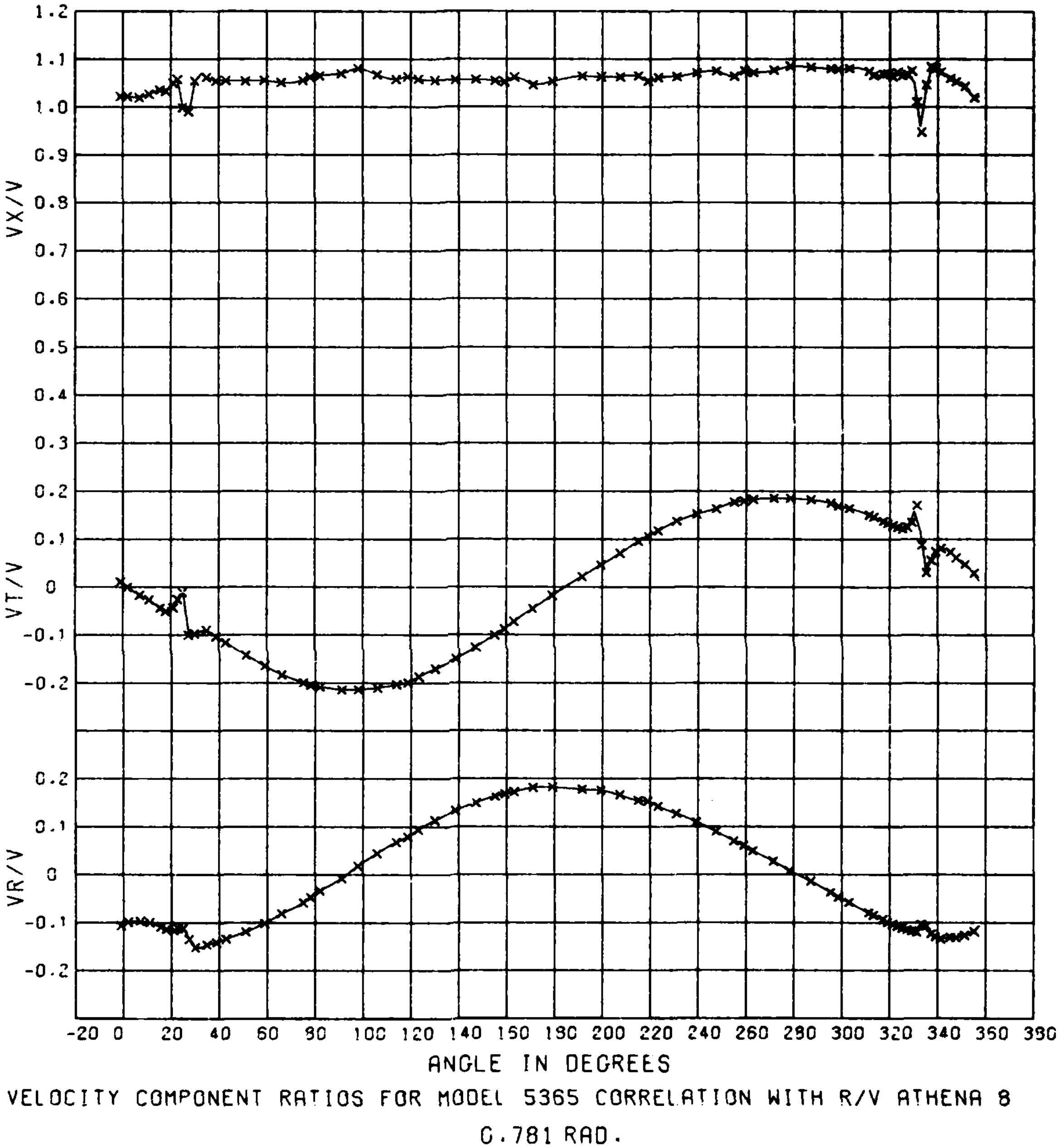

Figure F-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 8

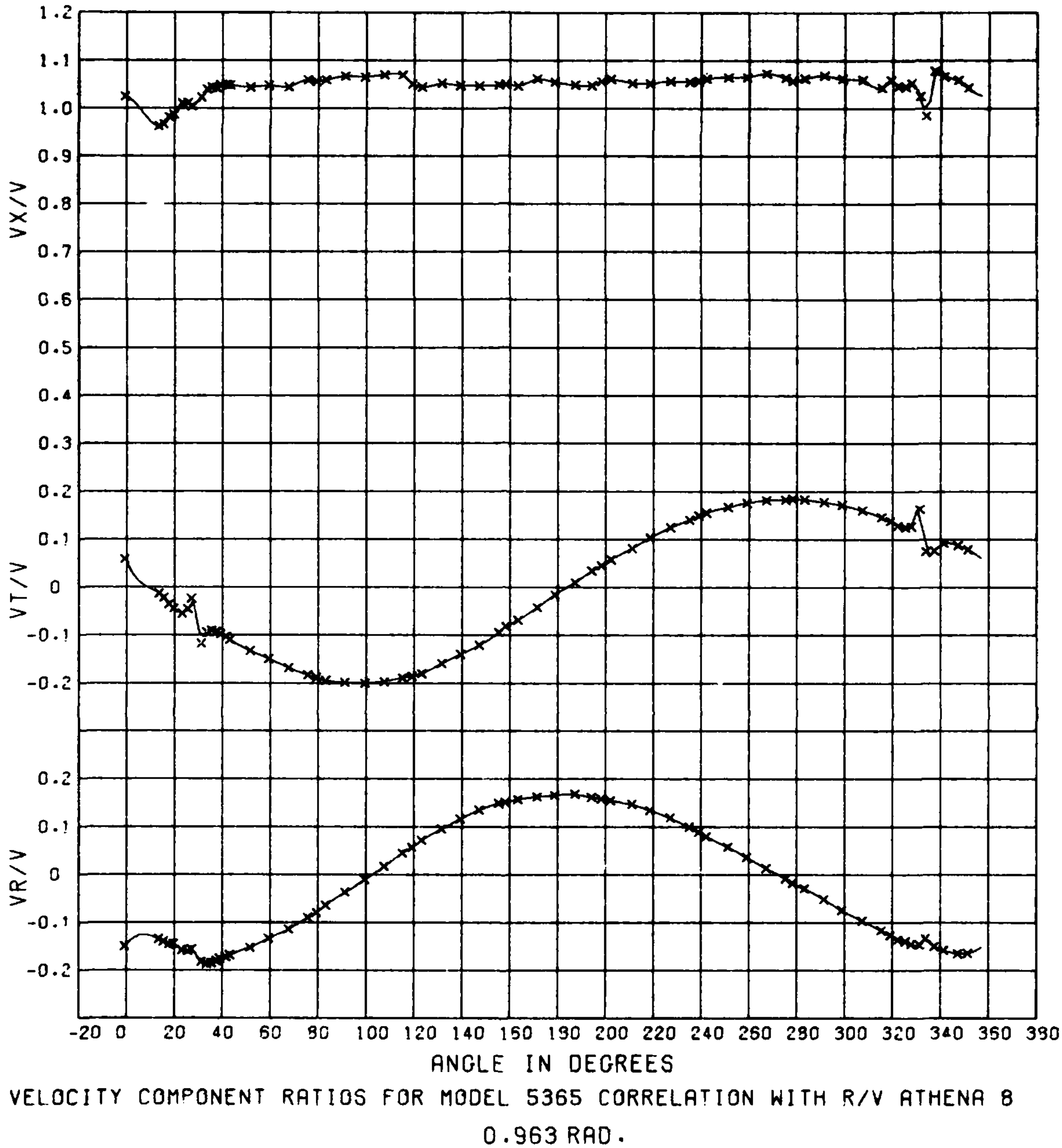

Figure F-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 8

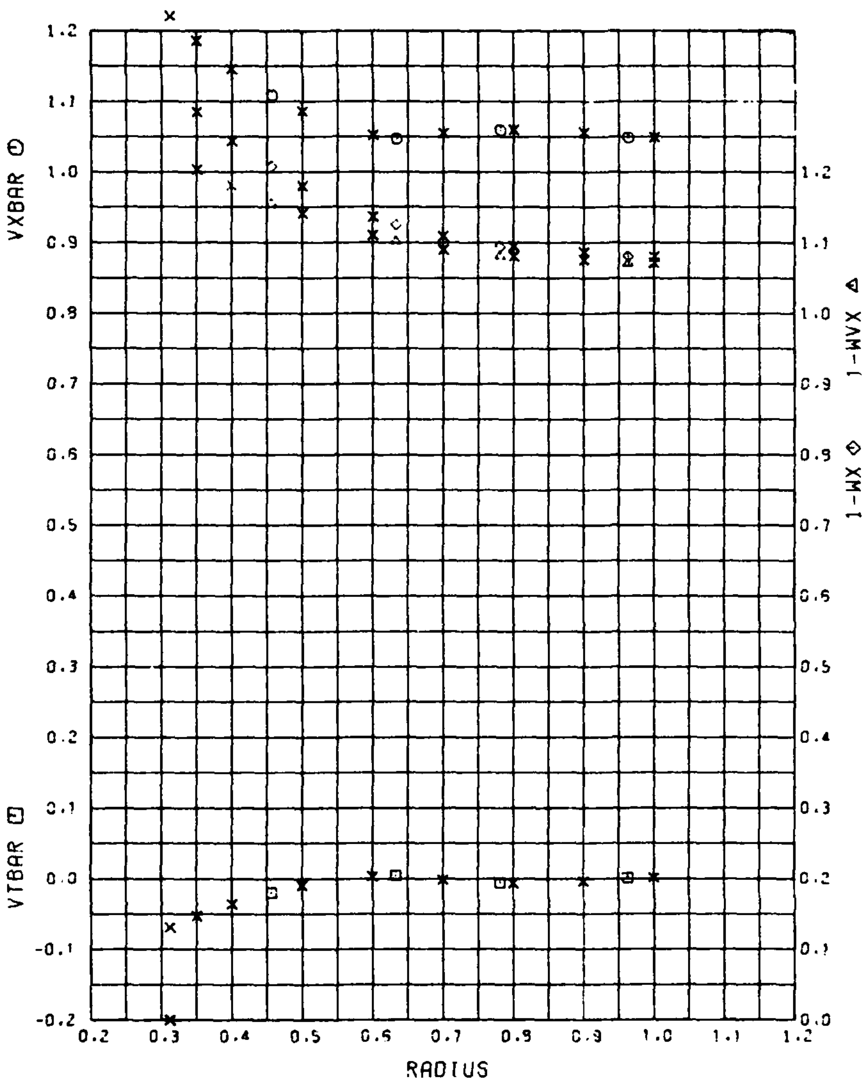

Figure F-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 8

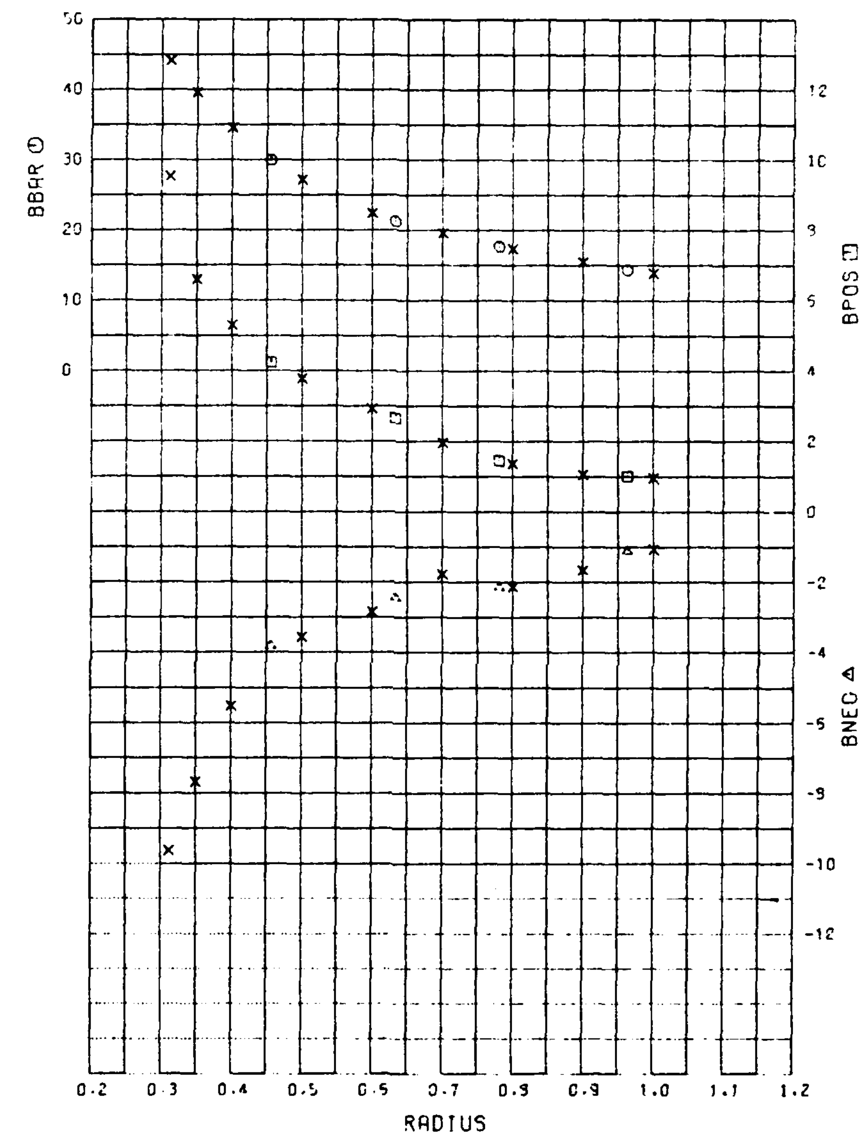

Figure F-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 8

TABLE F-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 8

	RADIUS = .456		
ANGLE	VX/V	VT/V	VR/V
1.1	.999	.012	-.002
5.1	.998	.007	-.010
9.1	.979	-.007	-.020
13.1	.968	-.019	-.044
17.1	.938	-.079	-.073
19.1	.936	-.126	-.048
19.2	.963	-.137	-.095
21.2	1.012	-.171	-.100
23.2	1.098	-.163	-.109
25.1	1.131	-.161	-.106
27.1	1.131	-.126	-.099
29.1	1.126	-.119	-.099
31.0	1.121	-.122	-.098
33.1	1.123	-.127	-.099
35.1	1.115	-.133	-.099
39.0	1.108	-.148	-.098
43.1	1.112	-.163	-.097
51.1	1.112	-.191	-.098
55.9	1.118	-.215	-.088
59.1	1.118	-.216	-.079
67.1	1.119	-.239	-.066
75.1	1.126	-.255	-.051
78.7	1.135	-.258	-.045
82.0	1.125	-.266	-.036
83.1	1.131	-.268	-.026
91.2	1.134	-.271	-.019
98.0	1.136	-.272	-.003
98.7	1.136	-.271	.006
107.2	1.129	-.267	.016
115.2	1.135	-.257	.031
119.1	1.136	-.250	.038
123.3	1.133	-.243	.048
131.0	1.130	-.223	.063
138.0	1.127	-.197	.076
139.3	1.134	-.196	.076
147.3	1.128	-.178	.088
155.3	1.123	-.148	.096
159.3	1.133	-.122	.103
163.0	1.125	-.106	.103
171.0	1.126	-.078	.107
175.0	1.118	-.033	.109
179.0	1.127	-.013	.108
183.0	1.128	-.019	.108
191.0	1.115	.012	.108
195.0	1.114	.049	.107
199.0	1.128	.065	.105
207.0	1.119	.078	.098
215.0	1.116	.109	.091
219.0	1.121	.125	.098
223.0	1.122	.134	.082
231.0	1.128	.155	.073
235.0	1.131	.181	.063
239.0	1.131	.183	.063
247.0	1.132	.190	.040
255.0	1.136	.209	.035
259.0	1.141	.212	.027
263.0	1.136	.217	.020
271.5	1.136	.222	.004
279.3	1.138	.218	-.009
279.0	1.136	.215	-.009
287.5	1.139	.214	-.026
295.5	1.131	.205	-.030
298.0	1.127	.199	-.044
303.0	1.126	.192	-.053
311.1	1.125	.173	-.066
319.1	1.116	.158	-.075
319.0	1.116	.150	-.075
321.0	1.120	.144	-.077
323.0	1.118	.128	-.078
325.3	1.114	.133	-.081
327.3	1.121	.125	-.081
329.2	1.121	.123	-.083
331.0	1.119	.122	-.086
333.2	1.125	.127	-.088
335.2	1.103	.142	-.083
337.3	1.037	.151	-.090
338.0	1.018	.121	-.079
339.2	1.002	.119	-.078
341.2	1.015	.072	-.056
342.7	1.070	.061	-.049
346.0	1.043	.062	-.038
347.2	1.068	.058	-.035
351.2	1.024	.045	-.017
353.1	1.023	.036	-.012
357.1	1.018	.022	-.002
361.1	.999	.012	-.002
365.1	.998	.007	-.010

	RADIUS = .633		
ANGLE	VX/V	VT/V	VR/V
-.7	1.007	-.000	-.070
1.6	.997	-.005	-.073
5.6	.996	-.021	-.067
9.6	1.003	-.029	-.067
9.5	1.007	-.029	-.069
11.5	.990	-.040	-.072
13.0	.991	-.042	-.073
15.9	.997	-.049	-.081
17.6	1.007	-.050	-.090
19.9	1.000	-.046	-.092
19.5	1.013	-.046	-.090
21.0	.995	-.033	-.097
21.5	1.004	-.033	-.096
23.6	.969	-.037	-.102
25.0	.963	-.083	-.122
25.5	.951	-.086	-.123
27.6	.981	-.122	-.133
29.0	1.043	-.115	-.141
31.6	1.063	-.090	-.143
33.6	1.061	-.096	-.141
33.5	1.052	-.096	-.142
35.6	1.049	-.098	-.140
37.6	1.051	-.113	-.138
39.6	1.051	-.110	-.135
41.0	1.053	-.116	-.131
49.6	1.062	-.140	-.117
57.6	1.065	-.161	-.103
59.0	1.063	-.167	-.103
65.0	1.070	-.183	-.086
73.5	1.075	-.197	-.067
79.0	1.077	-.203	-.052
81.5	1.070	-.208	-.046
89.5	1.087	-.212	-.025
97.5	1.091	-.213	-.006
99.2	1.092	-.212	-.003
105.6	1.091	-.215	.015
113.6	1.076	-.204	.037
119.1	1.081	-.196	.051
121.0	1.063	-.153	.058
129.6	1.094	-.179	.077
137.0	1.062	-.153	.093
139.1	1.062	-.149	.097
139.1	1.052	-.140	.099
145.3	1.049	-.130	.109
153.2	1.062	-.104	.121
159.0	1.050	-.081	.125
161.2	1.030	-.076	.130
169.2	1.055	-.046	.132
174.0	1.040	-.015	.136
177.1	1.040	-.013	.137
179.0	1.039	-.007	.136
185.1	1.046	.016	.134
193.1	1.042	.042	.132
198.9	1.030	.056	.127
200.0	1.030	.072	.129
209.1	1.041	.100	.114
214.0	1.070	.127	.102
216.0	1.034	.127	.102
218.9	1.026	.132	.099
225.1	1.036	.150	.088
232.0	1.040	.170	.071
238.0	1.029	.185	.059
241.1	1.047	.187	.052
249.1	1.056	.201	.032
257.0	1.059	.213	.013
258.7	1.066	.210	.010
265.1	1.063	.210	-.005
273.1	1.059	.220	-.022
278.7	1.059	.218	-.034
280.0	1.061	.217	-.040
289.2	1.053	.213	-.059
297.2	1.056	.201	-.070
298.9	1.055	.198	-.080
305.3	1.056	.187	-.095
313.3	1.055	.149	-.110
313.1	1.046	.169	-.111
313.3	1.051	.169	-.108
317.2	1.055	.159	-.116
321.3	1.051	.140	-.123
329.7	1.050	.138	-.120
329.3	1.060	.129	-.135
331.3	1.050	.176	-.141
333.3	1.037	.150	-.145
335.0	.970	.160	-.146
335.3	.997	.161	-.146
335.3	.901	.165	-.147
337.0	.922	.094	-.129
337.3	.936	.143	-.128
339.3	.993	.032	-.115
339.3	.996	.035	-.115
339.7	.999	.039	-.113
343.5	1.059	.050	-.126
343.3	1.058	.040	-.126
347.0	1.024	.071	-.122
349.0	1.013	.040	-.117
355.1	1.002	.019	-.096
357.0	.996	.019	-.007
359.0	.996	.000	-.040
359.0	.997	.004	-.001
359.3	.997	.010	-.000
359.3	1.007	-.000	-.070

	RADIUS = .781		
ANGLE	VX/V	VT/V	VR/V
-1.0	1.022	.011	-.106
2.0	1.022	-.001	-.099
7.0	1.020	-.017	-.097
11.0	1.027	-.027	-.100
15.0	1.029	-.043	-.109
16.0	1.043	-.046	-.109
18.0	1.031	-.051	-.113
18.0	1.035	-.052	-.116
21.0	1.050	-.046	-.116
22.9	1.057	-.026	-.113
24.9	.999	-.011	-.112
26.9	.953	-.002	-.126
28.0	1.027	-.119	-.146
30.0	1.054	-.090	-.152
34.9	1.062	-.091	-.146
38.9	1.069	-.107	-.143
38.9	1.059	-.102	-.140
42.9	1.055	-.117	-.135
51.0	1.056	-.142	-.119
58.7	1.050	-.165	-.102
59.0	1.054	-.164	-.101
66.0	1.051	-.183	-.081
75.0	1.055	-.199	-.050
78.0	1.062	-.205	-.047
82.6	1.065	-.210	-.034
91.0	1.070	-.216	-.060
98.0	1.070	-.215	.010
98.0	1.091	-.213	.019
106.0	1.060	-.211	.046
114.0	1.058	-.253	.069
118.7	1.064	-.199	.079
123.1	1.056	-.100	.096
123.1	1.061	-.196	.095
130.0	1.056	-.171	.116
130.0	1.059	-.150	.136
139.1	1.052	-.150	.133
147.1	1.057	-.127	.149
155.1	1.055	-.101	.163
159.1	1.052	-.088	.160
163.2	1.062	-.073	.172
171.0	1.066	-.046	.191
179.0	1.069	-.018	.186
179.2	1.057	-.917	.181
191.5	1.045	.022	.170
195.6	1.060	.046	.177
199.5	1.066	.046	.176
207.6	1.043	.071	.166
215.0	1.065	.096	.155
219.0	1.056	.107	.153
223.0	1.059	.119	.143
223.9	1.063	.117	.142
231.0	1.062	.130	.120
239.3	1.073	.152	.110
239.5	1.069	.152	.109
247.5	1.075	.164	.090
255.0	1.059	.180	.071
255.0	1.069	.175	.070
259.2	1.076	.180	.051
263.0	1.072	.183	.056
271.5	1.077	.186	.026
270.0	1.093	.185	.009
279.0	1.090	.186	.007
287.0	1.083	.183	-.016
295.3	1.380	.175	-.037
298.0	1.082	.169	-.049
299.0	1.076	.170	-.046
303.0	1.081	.165	-.050
311.3	1.375	.151	-.083
313.2	1.066	.147	-.084
317.2	1.069	.130	-.096
319.0	1.064	.136	-.131
319.0	1.075	.132	-.059
321.2	1.064	.129	-.103
323.2	1.073	.129	-.107
325.2	1.064	.121	-.111
327.2	1.067	.125	-.115
329.0	1.076	.136	-.118
331.7	1.011	.171	-.120
333.1	.960	.090	-.106
335.1	1.067	.071	-.107
337.1	1.086	.057	-.176
338.9	1.089	.073	-.130
339.1	1.077	.076	-.131
341.1	1.073	.081	-.136
345.1	1.060	.076	-.131
347.1	1.053	.067	-.133
348.0	1.053	.057	-.133
351.1	1.043	.040	-.127
355.0	1.020	.029	-.119
357.5	1.022	.011	-.106

	RADIUS = .963		
ANGLE	VX/V	VT/V	VR/V
-.0	1.025	.059	-.150
13.6	.963	-.013	-.136
13.6	.962	-.012	-.136
15.6	.967	-.022	-.141
17.5	.982	-.036	-.146
19.5	.987	-.065	-.145
23.0	1.011	-.056	-.156
25.6	1.012	-.066	-.159
27.0	1.006	-.026	-.156
31.0	1.023	-.110	-.187
33.6	1.040	-.096	-.186
35.6	1.044	-.091	-.185
37.6	1.042	-.096	-.180
39.0	1.040	-.090	-.176
41.6	1.049	-.106	-.173
43.0	1.040	-.110	-.169
51.5	1.043	-.133	-.153
59.0	1.052	-.149	-.133
59.3	1.043	-.151	-.136
67.5	1.044	-.168	-.116
75.5	1.059	-.183	-.099
79.1	1.056	-.189	-.088
83.0	1.059	-.195	-.064
91.0	1.067	-.198	-.037
99.0	1.066	-.203	-.011
99.5	1.065	-.200	-.013
107.6	1.069	-.197	.017
115.0	1.070	-.189	.045
119.0	1.050	-.186	.057
123.0	1.065	-.180	.073
131.3	1.052	-.159	.096
139.0	1.049	-.140	.116
139.3	1.046	-.161	.110
147.0	1.347	-.121	.135
155.1	1.040	-.095	.149
158.3	1.053	-.082	.151
163.1	1.047	-.069	.157
171.1	1.062	-.042	.162
178.0	1.053	-.016	.166
179.0	1.057	-.016	.166
187.0	1.069	.010	.169
194.0	1.040	.036	.162
198.0	1.057	.046	.150
202.0	1.041	.059	.155
210.9	1.052	.082	.167
218.0	1.056	.106	.136
218.7	1.060	.106	.135
226.9	1.057	.125	.119
234.9	1.055	.141	.099
238.0	1.057	.158	.089
242.0	1.062	.156	.080
251.0	1.065	.160	.059
258.7	1.342	.176	.037
259.0	1.069	.177	.035
267.0	1.073	.182	.013
275.0	1.066	.183	-.008
278.0	1.050	.185	-.018
283.0	1.063	.183	-.029
291.1	1.069	.178	-.052
298.0	1.063	.172	-.075
299.1	1.060	.173	-.076
307.1	1.060	.161	.096
315.1	1.047	.147	-.116
318.9	1.059	.139	-.127
322.0	1.066	.129	-.136
325.1	1.065	.125	-.140
327.1	1.056	.176	-.143
328.0	1.051	.132	-.140
331.2	1.025	.166	-.147
333.1	.932	.187	-.131
336.0	1.139	.065	-.135
337.1	1.079	.077	-.153
341.2	1.067	.093	-.150
347.0	1.059	.080	-.165
351.2	1.043	.079	-.165
357.9	1.025	.059	-.150

TABLE F-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 8

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 8 WITH PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	1.109	1.047	1.059	1.049	1.221	1.186	1.146	1.086	1.052	1.055	1.060	1.056	1.049
VTBAR =	-.020	.004	-.006	.001	-.069	-.053	-.036	-.010	.003	-.002	-.007	-.004	.001
VRBAR =	.006	-.007	.017	-.009	.051	.036	.020	-.002	-.008	.009	.017	.007	-.009
1-WVX =	1.155	1.102	1.081	1.071	0.000	1.203	1.181	1.141	1.110	1.090	1.081	1.076	1.071
1-WX =	1.208	1.125	1.095	1.081	0.000	1.285	1.244	1.180	1.136	1.109	1.095	1.087	1.080
BBAR =	30.02	21.22	17.72	14.37	44.15	39.58	34.53	27.16	22.39	19.53	17.33	15.44	13.86
BPOS =	4.24	2.65	1.45	1.01	9.53	6.59	5.29	3.78	2.92	1.95	1.36	1.05	.95
THETA =	97.50	95.00	97.50	110.00	22.50	100.00	100.00	95.00	95.00	95.00	97.50	100.00	110.00
BNEG =	-3.82	-2.45	-2.15	-1.11	-9.63	-7.68	-5.52	-3.57	-2.85	-1.78	-2.14	-1.66	-1.07
THETA =	340.00	337.50	332.50	12.50	15.00	15.00	15.00	337.50	337.50	332.50	332.50	332.50	12.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE F-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 8

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 8 WITH PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0334	.0351	.0211	.0160	.0142	.0099	.0065	.0059
PHASE ANGLE =	266.3	260.1	269.0	257.4	255.5	240.3	216.8	172.9
RADIUS = .633								
AMPLITUDE =	.0132	.0263	.0114	.0028	.0061	.0016	.0039	.0041
PHASE ANGLE =	312.9	258.2	247.8	203.1	244.7	248.0	109.4	104.1
RADIUS = .781								
AMPLITUDE =	.0102	.0145	.0061	.0024	.0019	.0033	.0048	.0001
PHASE ANGLE =	218.6	254.5	246.8	328.9	257.7	211.1	164.9	223.0
RADIUS = .963								
AMPLITUDE =	.0138	.0167	.0086	.0048	.0069	.0085	.0070	.0060
PHASE ANGLE =	246.1	251.9	219.6	174.9	210.7	184.3	162.7	175.0

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0061	.0082	.0086	.0080	.0064	.0046	.0027	.0027
PHASE ANGLE =	130.1	121.7	111.8	104.9	91.7	80.3	53.7	340.3
RADIUS = .633								
AMPLITUDE =	.0029	.0029	.0019	.0008	.0024	.0041	.0047	.0038
PHASE ANGLE =	68.9	106.2	90.4	310.5	257.9	272.4	260.6	272.9
RADIUS = .781								
AMPLITUDE =	.0009	.0030	.0025	.0033	.0033	.0035	.0021	.0029
PHASE ANGLE =	172.8	239.2	263.0	301.7	279.5	297.3	299.6	302.3
RADIUS = .963								
AMPLITUDE =	.0033	.0028	.0007	.0025	.0008	.0015	.0022	.0027
PHASE ANGLE =	174.2	153.2	12.0	192.4	319.5	320.5	341.1	65.8

TABLE F-4 – HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 8

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 8 WITH PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.0775	.0380	.0343	.0393	.0235	.0247	.0235	.0153
PHASE ANGLE =	241.8	261.2	283.1	269.4	262.9	235.4	231.2	213.3
RADIUS = .350								
AMPLITUDE =	.0630	.0376	.0303	.0321	.0208	.0201	.0181	.0120
PHASE ANGLE =	246.3	260.9	279.9	267.2	261.2	236.4	229.8	206.9
RADIUS = .400								
AMPLITUDE =	.0470	.0367	.0256	.0238	.0175	.0148	.0119	.0085
PHASE ANGLE =	254.2	260.5	275.1	263.4	258.6	237.9	226.3	194.5
RADIUS = .500								
AMPLITUDE =	.0257	.0334	.0181	.0112	.0118	.0068	.0035	.0049
PHASE ANGLE =	278.5	259.7	263.8	250.4	252.8	242.8	195.6	151.0
RADIUS = .600								
AMPLITUDE =	.0157	.0283	.0128	.0041	.0074	.0023	.0034	.0043
PHASE ANGLE =	307.4	258.7	251.4	219.6	246.5	249.4	113.6	111.5
RADIUS = .700								
AMPLITUDE =	.0073	.0194	.0083	.0015	.0035	.0022	.0037	.0016
PHASE ANGLE =	263.8	256.9	249.9	296.3	255.3	231.8	143.5	88.7
RADIUS = .800								
AMPLITUDE =	.0110	.0139	.0059	.0023	.0018	.0037	.0051	.0005
PHASE ANGLE =	216.0	253.9	244.7	329.8	252.1	206.9	167.0	222.1
RADIUS = .900								
AMPLITUDE =	.0131	.0138	.0065	.0009	.0037	.0063	.0064	.0031
PHASE ANGLE =	224.5	251.7	227.8	205.0	216.2	190.7	168.0	187.3
RADIUS = 1.000								
AMPLITUDE =	.0138	.0167	.0086	.0048	.0069	.0085	.0070	.0060
PHASE ANGLE =	246.1	251.9	219.6	174.9	210.7	184.3	162.7	175.0

TABLE F-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 8 WITH PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0148	.0137	.0162	.0200	.0198	.0196	.0175	.0092
PHASE ANGLE =	158.9	141.1	122.2	104.9	86.1	80.8	66.0	33.4
RADIUS = .350								
AMPLITUDE =	.0119	.0120	.0140	.0164	.0157	.0149	.0128	.0068
PHASE ANGLE =	154.0	136.2	119.8	105.0	87.0	81.0	65.3	27.7
RADIUS = .400								
AMPLITUDE =	.0087	.0101	.0113	.0122	.0109	.0095	.0074	.0043
PHASE ANGLE =	145.0	129.4	116.3	105.0	88.6	81.0	63.3	13.7
RADIUS = .500								
AMPLITUDE =	.0047	.0068	.0067	.0052	.0035	.0014	.0008	.0026
PHASE ANGLE =	114.4	115.9	107.8	104.3	97.0	74.3	312.3	306.7
RADIUS = .600								
AMPLITUDE =	.0032	.0039	.0029	.0005	.0015	.0033	.0043	.0037
PHASE ANGLE =	77.1	106.4	96.1	70.4	247.1	271.6	260.6	274.7
RADIUS = .700								
AMPLITUDE =	.0012	.0013	.0009	.0026	.0031	.0039	.0032	.0036
PHASE ANGLE =	83.0	207.2	252.3	307.7	271.4	285.4	272.6	285.9
RADIUS = .800								
AMPLITUDE =	.0012	.0032	.0026	.003[illegible]	.[illegible]032	.0034	.0020	.0027
PHASE ANGLE =	181.8	239.0	264.0	299.[illegible]	28[illegible].0	299.6	307.4	307.4
RADIUS = .900								
AMPLITUDE =	.0025	.0025	.0018	.0020	.0021	.0024	.0020	.0016
PHASE ANGLE =	183.7	212.5	275.0	261.1	290.9	311.0	337.3	13.6
RADIUS = 1.000								
AMPLITUDE =	.0033	.0028	.0007	.0025	.0008	.0015	.0022	.0027
PHASE ANGLE =	174.2	153.2	12.0	192.4	319.5	320.5	341.1	65.8

RADII FOR EXPERIMENT 8

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 8 WITH PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2463	.0063	.0016	.0042	.0033	.0035	.0026	.0032
PHASE ANGLE =	175.1	82.8	193.0	157.1	159.9	132.0	97.0	64.6
RADIUS = .633								
AMPLITUDE =	.2161	.0029	.0045	.0031	.0023	.0018	.0011	.0011
PHASE ANGLE =	177.0	356.5	269.0	240.0	255.7	234.6	270.7	329.6
RADIUS = .781								
AMPLITUDE =	.1981	.0070	.0035	.0022	.0018	.0011	.0011	.0003
PHASE ANGLE =	174.9	66.9	316.7	263.9	271.5	241.2	268.5	130.9
RADIUS = .963								
AMPLITUDE =	.1919	.0096	.0008	.0029	.0022	.0022	.0016	.0012
PHASE ANGLE =	173.0	82.3	140.3	136.4	125.5	115.0	114.7	112.2

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0042	.0048	.0059	.0055	.0045	.0035	.0023	.0019
PHASE ANGLE =	24.4	27.5	7.5	7.0	.4	338.7	328.0	261.6
RADIUS = .633								
AMPLITUDE =	.0018	.0009	.0009	.0008	.0012	.0021	.0025	.0023
PHASE ANGLE =	328.2	333.8	305.0	199.7	184.7	167.5	175.1	172.7
RADIUS = .781								
AMPLITUDE =	.0008	.0009	.0017	.0021	.0024	.0020	.0017	.0010
PHASE ANGLE =	253.4	183.5	170.2	192.9	191.0	186.1	205.6	244.4
RADIUS = .963								
AMPLITUDE =	.0011	.0016	.0017	.0017	.0022	.0018	.0018	.0009
PHASE ANGLE =	140.3	152.3	147.4	172.7	170.3	184.2	203.5	205.4

AD-A092 246 DAVID W TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CE--ETC F/G 20/4
ANALYSIS OF WAKE SURVEY EXPERIMENTAL DATA FOR MODEL 5365 REPRES--ETC(U)
OCT 80 R B HURWITZ, L B CROOK

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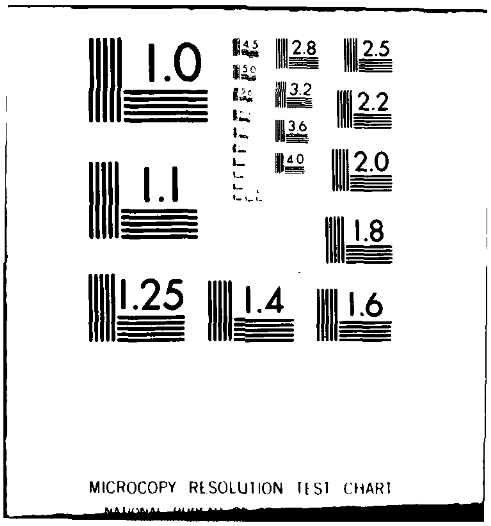
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MICROCOPY RESOLUTION TEST CHART

TABLE F-6 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 8

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 8 WITH PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2789	.0231	.0085	.0110	.0095	.0104	.0086	.0093
PHASE ANGLE =	171.1	96.6	99.2	124.8	133.7	111.8	96.0	84.7
RADIUS = .350								
AMPLITUDE =	.2695	.0176	.0058	.0087	.0075	.0082	.0068	.0073
PHASE ANGLE =	172.3	95.2	105.2	129.6	137.3	114.5	96.1	81.7
RADIUS = .400								
AMPLITUDE =	.2580	.0115	.0029	.0062	.0052	.0057	.0047	.0051
PHASE ANGLE =	173.7	91.8	123.1	139.1	144.6	120.1	96.3	75.8
RADIUS = .500								
AMPLITUDE =	.2379	.0035	.0025	.0032	.0023	.0022	.0014	.0021
PHASE ANGLE =	175.9	64.5	236.9	179.0	182.1	150.7	98.4	48.7
RADIUS = .600								
AMPLITUDE =	.2210	.0027	.0043	.0030	.0021	.0017	.0007	.0012
PHASE ANGLE =	177.0	356.6	263.5	230.0	245.0	222.0	268.5	345.4
RADIUS = .700								
AMPLITUDE =	.2065	.0044	.0040	.0028	.0023	.0017	.0013	.0004
PHASE ANGLE =	176.1	48.1	295.4	257.1	267.6	243.6	272.0	329.5
RADIUS = .800								
AMPLITUDE =	.1967	.0075	.0033	.0019	.0016	.0010	.0010	.0004
PHASE ANGLE =	174.7	69.2	320.3	262.7	270.6	236.4	266.1	131.3
RADIUS = .900								
AMPLITUDE =	.1921	.0093	.0014	.0010	.0006	.0010	.0005	.0010
PHASE ANGLE =	173.6	77.9	337.0	174.2	165.8	135.0	147.5	122.2
RADIUS = 1.000								
AMPLITUDE =	.1919	.0096	.0008	.0029	.0022	.0022	.0016	.0012
PHASE ANGLE =	173.0	82.3	140.3	136.4	125.5	115.0	114.7	112.2

TABLE F-6 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 8 WITH PROPELLER
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0087	.0108	.0132	.0145	.0127	.0127	.0110	.0081
PHASE ANGLE =	47.2	39.2	19.1	8.0	359.6	338.4	336.0	307.0
RADIUS = .350								
AMPLITUDE =	.0073	.0090	.0110	.0118	.0103	.0098	.0083	.0059
PHASE ANGLE =	42.7	36.9	16.8	7.8	359.8	338.6	335.5	302.7
RADIUS = .400								
AMPLITUDE =	.0057	.0069	.0084	.0086	.0073	.0066	.0052	.0036
PHASE ANGLE =	35.4	33.2	13.1	7.6	.1	338.8	333.9	292.1
RADIUS = .500								
AMPLITUDE =	.0034	.0035	.0043	.0035	.0027	.0015	.0007	.0016
PHASE ANGLE =	13.3	21.4	1.4	6.1	.6	337.2	296.2	218.0
RADIUS = .600								
AMPLITUDE =	.0021	.0013	.0015	.0002	.0005	.0015	.0021	.0023
PHASE ANGLE =	340.3	353.7	331.4	287.1	185.8	167.3	175.8	175.2
RADIUS = .700								
AMPLITUDE =	.0011	.0003	.0007	.0016	.0019	.0020	.0020	.0013
PHASE ANGLE =	302.5	242.5	198.3	196.3	191.3	178.1	189.4	198.8
RADIUS = .800								
AMPLITUDE =	.0007	.0011	.0018	.0022	.0024	.0020	.0017	.0010
PHASE ANGLE =	240.3	179.7	167.7	191.9	190.2	187.2	208.2	250.9
RADIUS = .900								
AMPLITUDE =	.0008	.0015	.0020	.0021	.0024	.0019	.0017	.0009
PHASE ANGLE =	175.0	164.0	157.3	183.8	181.7	188.2	211.0	247.0
RADIUS = 1.000								
AMPLITUDE =	.0011	.0016	.0017	.0017	.0022	.0018	.0018	.0009
PHASE ANGLE =	140.3	152.3	147.4	172.7	170.3	184.2	203.5	205.4

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APPENDIX G

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

FOR EXPERIMENT 19

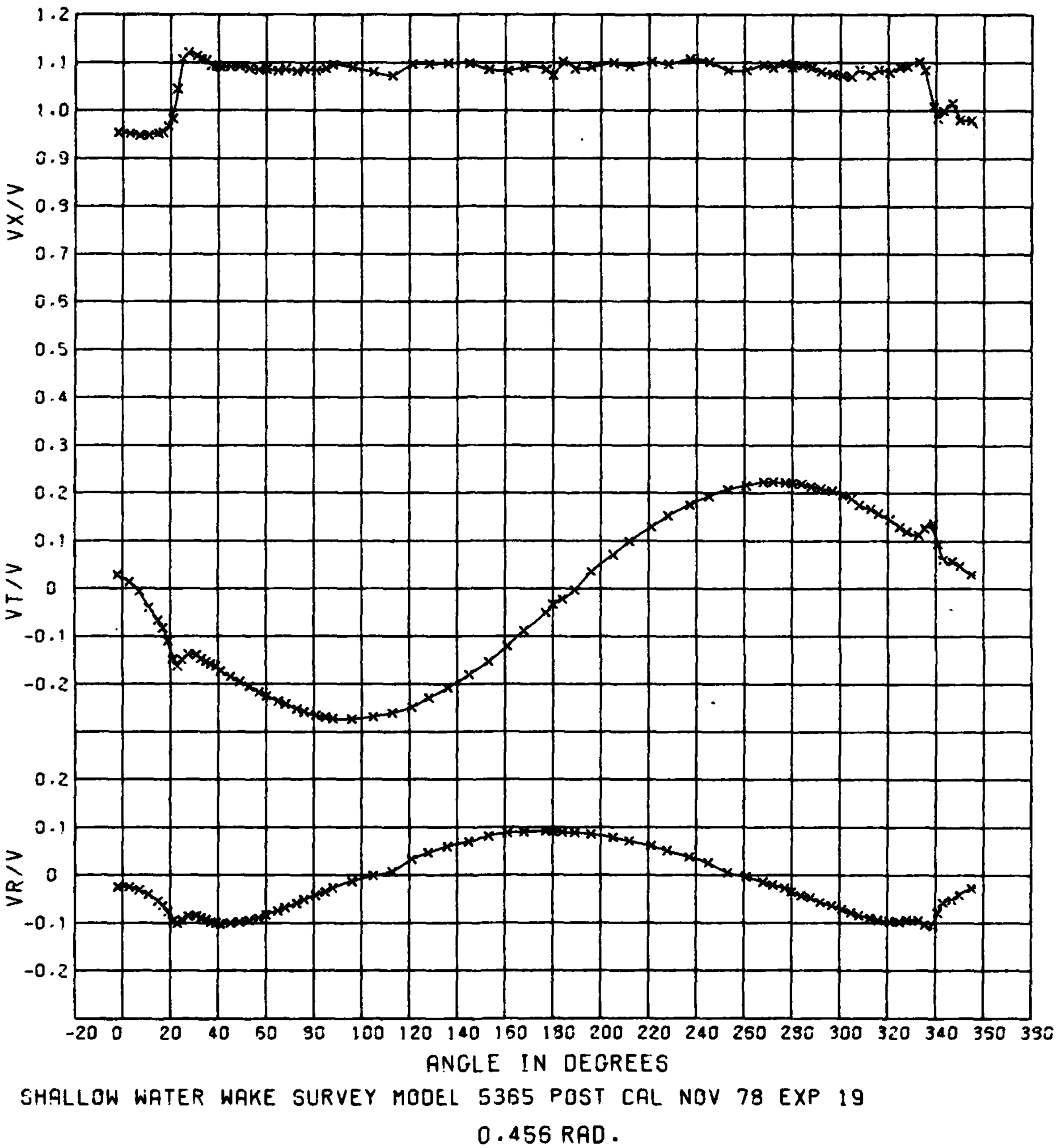

Figure G-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 19

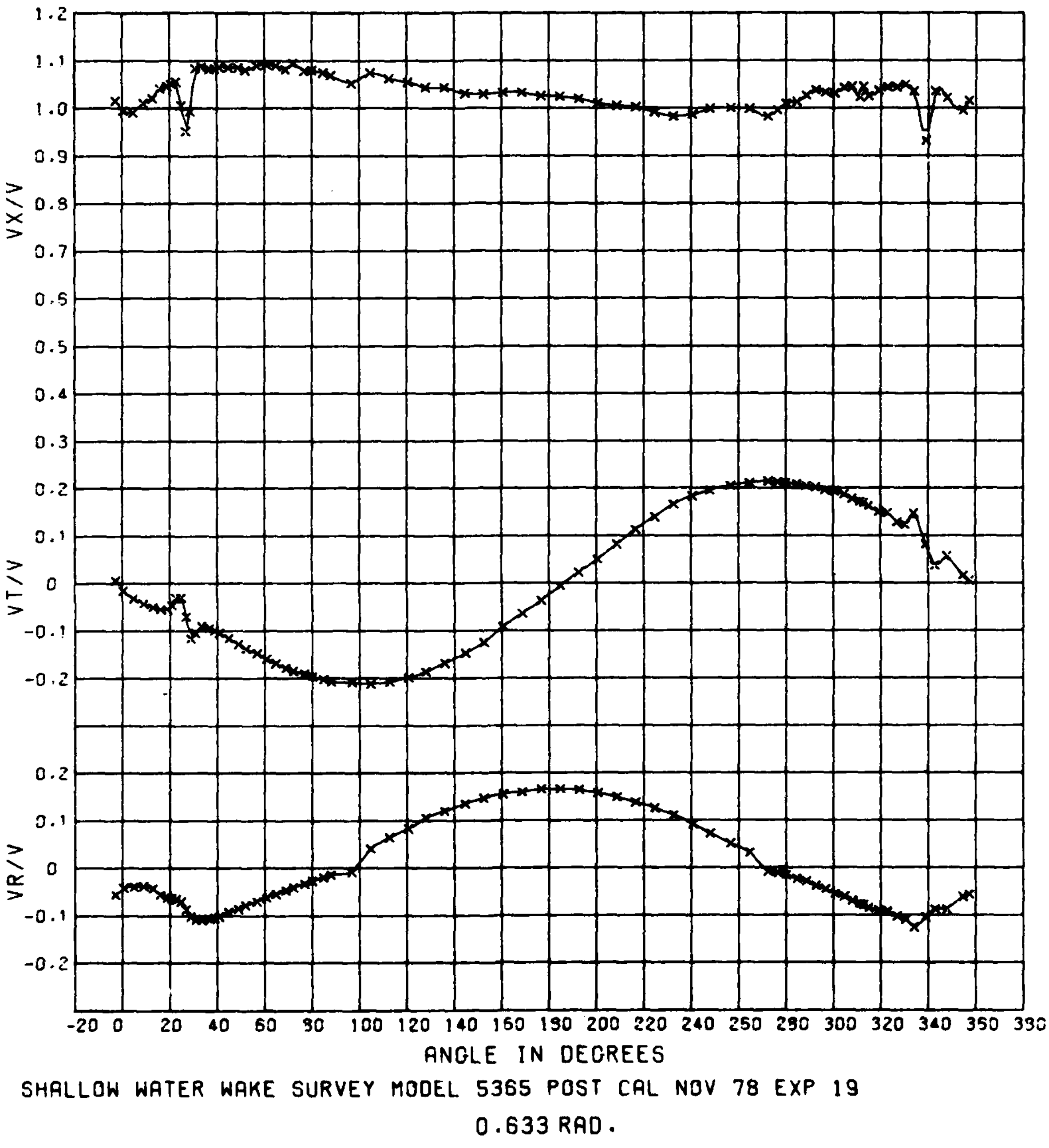

Figure G-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 19

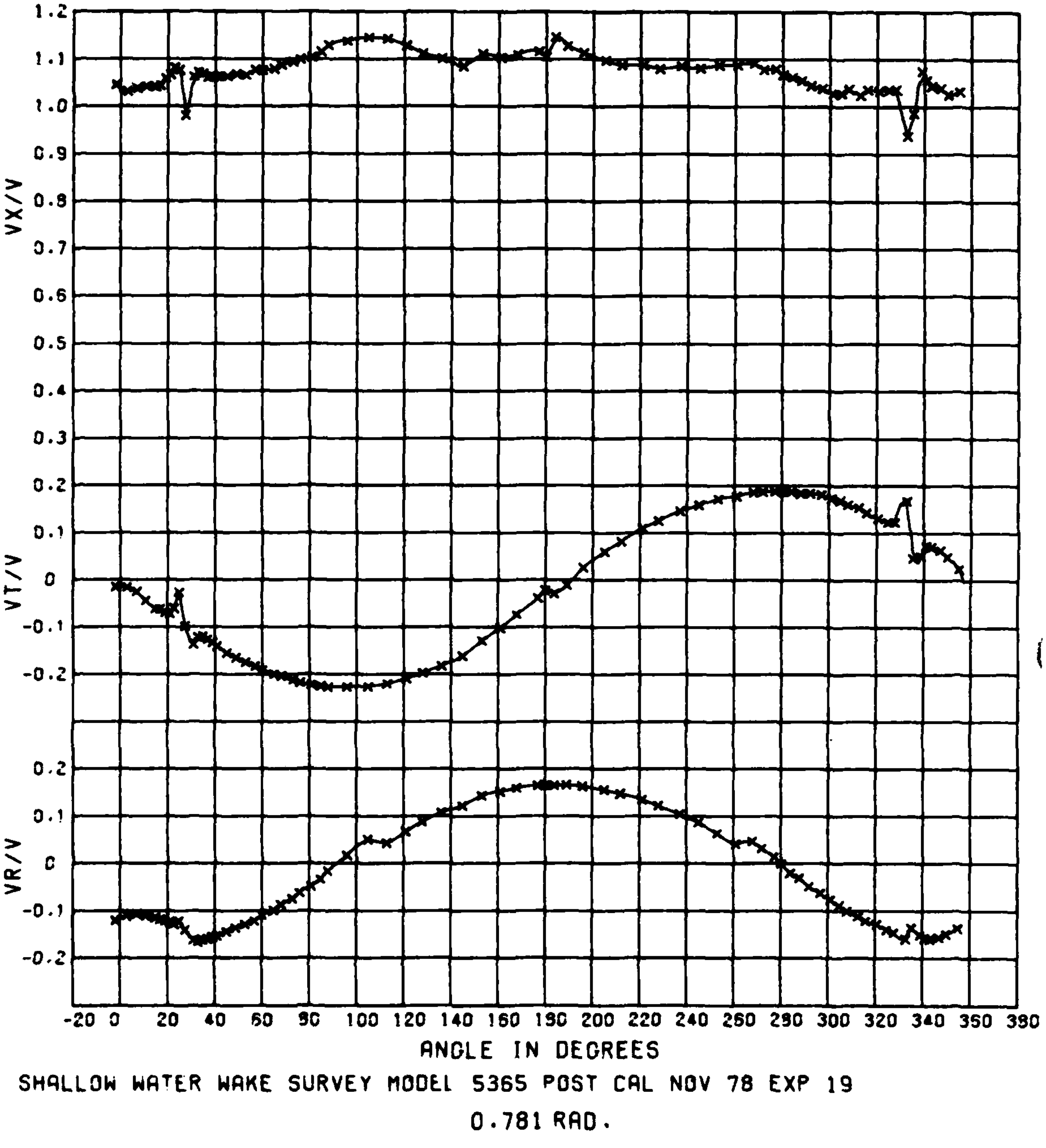

Figure G-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 19

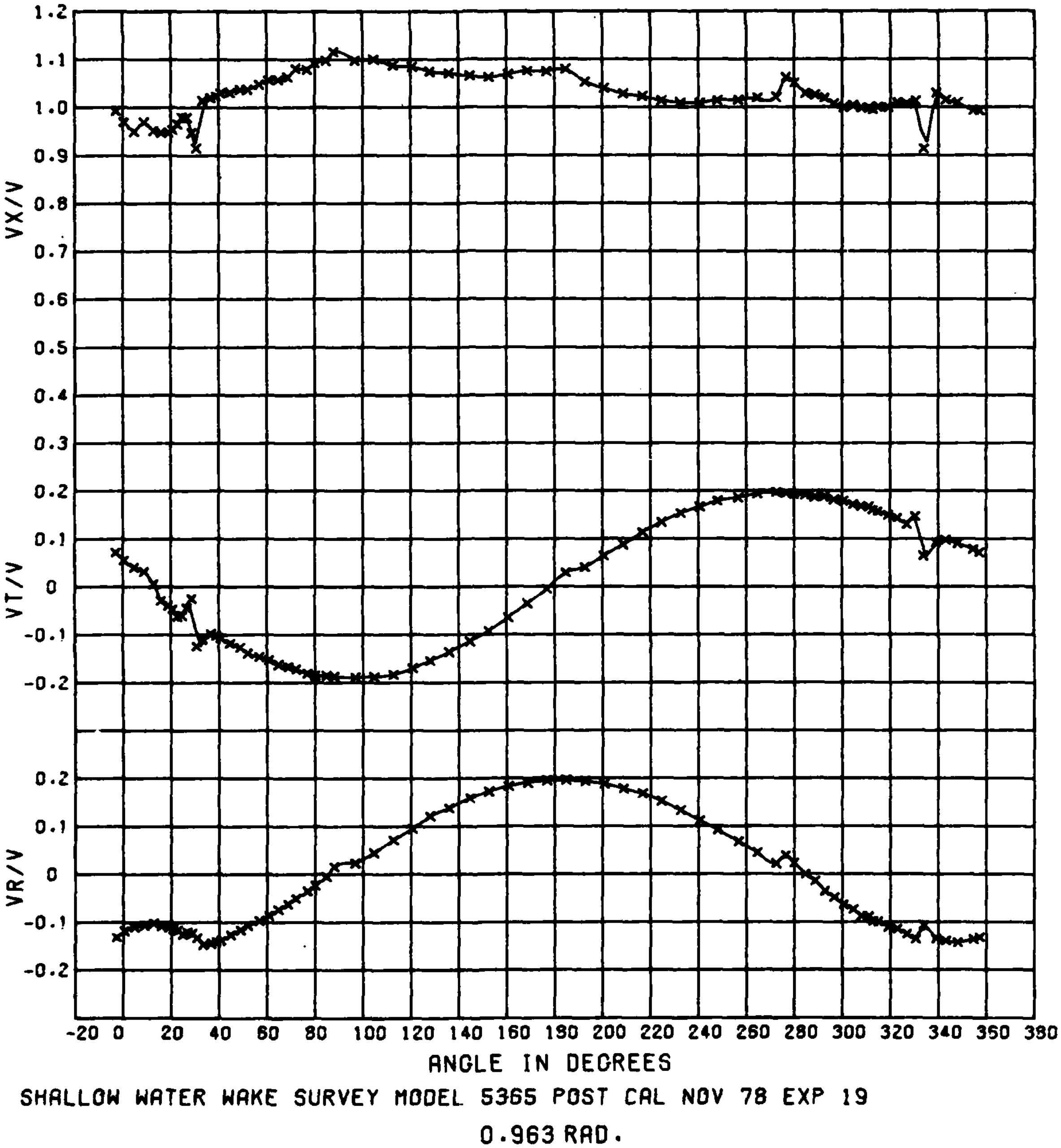

Figure G-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 19

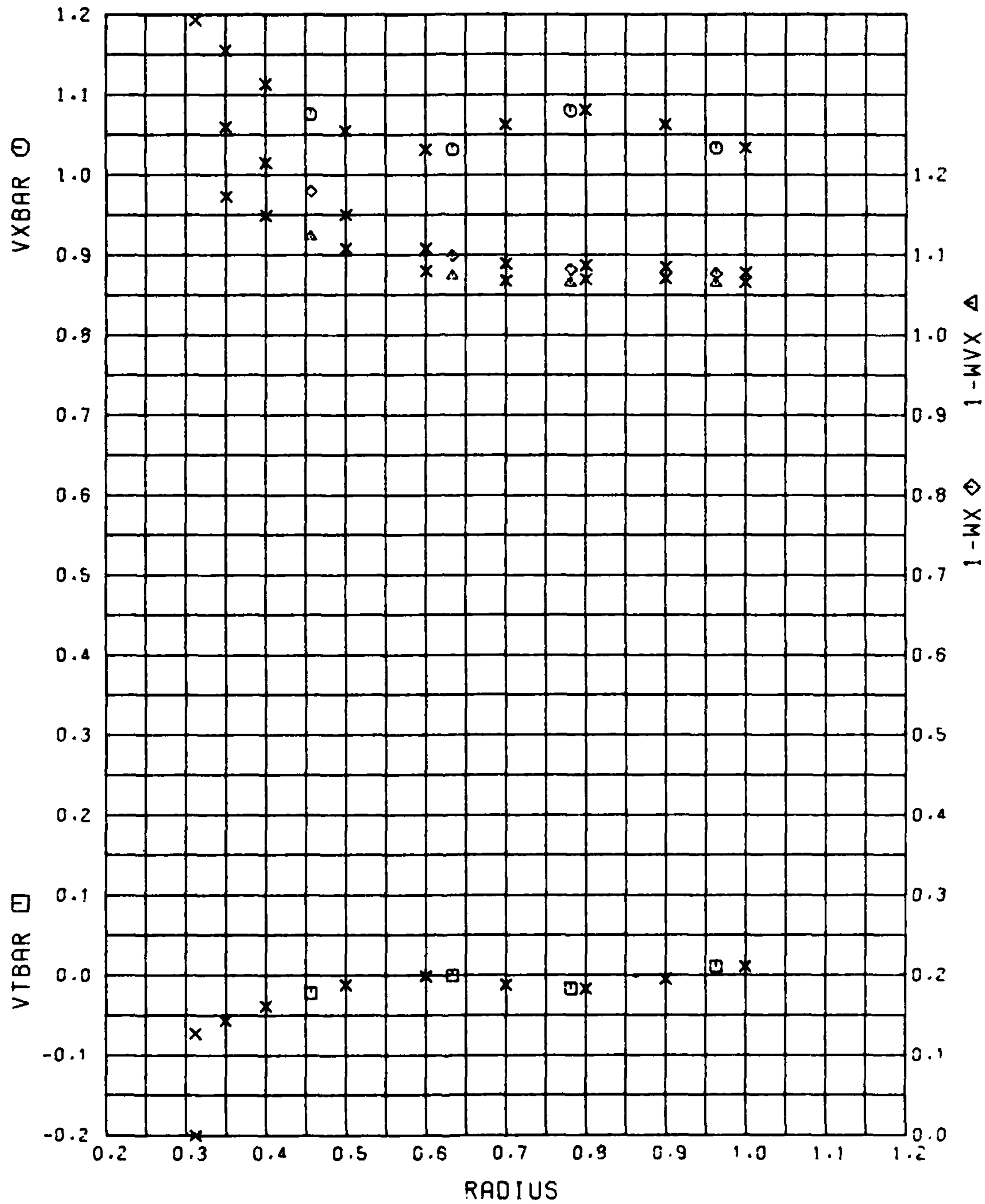

Figure G-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 19

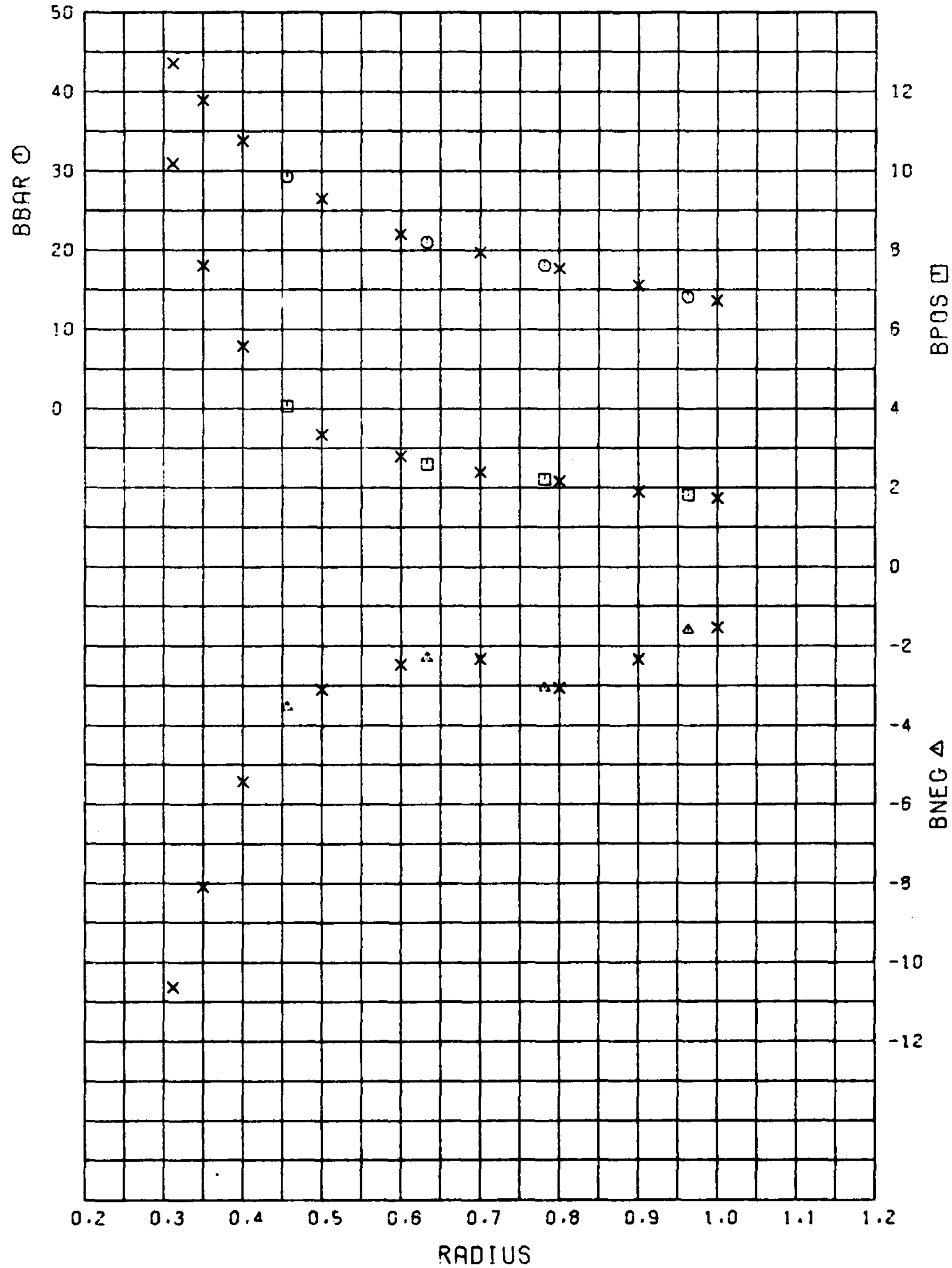

Figure G-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 19

TABLE G-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 19

RADIUS = .496

ANGLE	VX/V	VT/V	VR/V
-2.0	.954	.029	-.026
2.9	.952	.014	-.026
7.0	.948	-.006	-.031
10.9	.948	-.040	-.040
14.9	.952	-.067	-.056
16.9	.956	-.083	-.066
19.0	.960	-.110	-.077
21.0	.983	-.140	-.096
22.9	1.045	-.162	-.101
24.9	1.107	-.169	-.094
26.9	1.126	-.138	-.086
28.0	1.116	-.136	-.085
30.9	1.114	-.139	-.085
32.9	1.108	-.147	-.089
34.9	1.106	-.153	-.093
36.9	1.094	-.158	-.098
39.0	1.093	-.162	-.108
40.9	1.091	-.173	-.102
45.0	1.091	-.184	-.108
48.9	1.092	-.195	-.098
52.9	1.088	-.205	-.096
56.9	1.085	-.217	-.090
60.0	1.087	-.229	-.083
64.9	1.083	-.237	-.075
68.0	1.087	-.243	-.068
72.9	1.082	-.252	-.059
76.3	1.087	-.259	-.051
80.9	1.083	-.266	-.042
84.9	1.088	-.270	-.035
88.0	1.095	-.273	-.026
96.0	1.090	-.274	-.013
104.9	1.081	-.269	-.001
112.9	1.073	-.261	.007
121.0	1.097	-.249	.033
128.0	1.097	-.229	.047
136.0	1.099	-.200	.060
144.9	1.090	-.180	.070
153.1	1.086	-.153	.081
161.0	1.083	-.121	.088
168.0	1.090	-.088	.090
177.0	1.086	-.051	.092
180.0	1.074	-.033	.091
184.0	1.102	-.022	.090
189.2	1.087	-.003	.089
196.0	1.091	.036	.086
205.1	1.099	.071	.079
212.0	1.092	.099	.072
221.2	1.102	.130	.062
228.0	1.097	.153	.052
237.1	1.100	.175	.038
245.1	1.102	.193	.026
253.1	1.084	.208	.005
260.9	1.086	.216	-.003
[illegible]	1.095	.223	-.014
[illegible]	1.089	.226	-.020
[illegible]	1.097	.222	-.027
[illegible]	1.089	.221	-.036
284.0	1.095	.220	-.042
288.0	1.090	.214	-.047
292.0	1.083	.210	-.057
296.0	1.076	.205	-.066
301.0	1.076	.196	-.071
304.0	1.071	.189	-.078
308.0	1.086	.175	-.086
312.0	1.076	.167	-.090
316.0	1.085	.157	-.095
320.0	1.088	.146	-.098
324.9	1.091	.130	-.096
328.0	1.092	.120	-.094
332.9	1.102	.113	-.095
334.9	1.090	.119	-.100
338.0	1.071	.135	-.105
338.9	1.080	.137	-.100
340.9	.986	.094	-.078
343.0	1.000	.061	-.057
343.0	1.000	.061	-.057
346.9	1.016	.050	-.052
350.0	.981	.040	-.041
354.9	.980	.030	-.027
358.0	.994	.029	-.024

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
-2.9	1.016	.006	-.056
0.0	.987	-.016	-.043
1.0	1.003	-.017	-.039
4.0	.991	-.032	-.039
8.9	1.011	-.042	-.037
12.0	1.021	-.050	-.042
16.0	1.042	-.055	-.056
18.9	1.046	-.050	-.062
19.0	1.040	-.055	-.062
20.0	1.051	-.066	-.063
22.0	1.056	-.031	-.065
24.0	1.006	-.030	-.070
26.0	.952	-.070	-.087
28.7	.994	-.116	-.102
30.0	1.004	-.105	-.109
32.0	1.006	-.092	-.111
34.0	1.007	-.089	-.108
36.7	1.002	-.094	-.107
38.0	1.003	-.099	-.104
40.0	1.007	-.104	-.102
44.0	1.006	-.116	-.093
48.9	1.005	-.128	-.086
52.0	1.000	-.138	-.078
56.0	1.090	-.147	-.070
60.0	1.092	-.159	-.062
64.7	1.089	-.160	-.054
68.0	1.082	-.170	-.047
72.0	1.095	-.186	-.040
76.7	1.078	-.190	-.033
80.0	1.080	-.196	-.026
84.7	1.079	-.202	-.019
88.0	1.069	-.207	-.014
96.7	1.052	-.208	-.008
104.6	1.075	-.212	.041
112.6	1.063	-.207	.065
120.6	1.055	-.199	.083
128.0	1.046	-.186	.106
136.0	1.043	-.160	.120
144.6	1.031	-.147	.135
152.5	1.029	-.125	.167
160.6	1.033	-.092	.155
168.6	1.033	-.064	.160
176.6	1.026	-.037	.165
184.6	1.025	-.006	.166
192.6	1.020	.022	.166
200.6	1.012	.051	.150
208.6	1.010	.050	.158
208.6	1.005	.082	.149
216.6	1.003	.113	.130
224.6	.992	.140	.126
232.6	.983	.160	.111
240.6	.987	.183	.092
248.0	.999	.195	.072
256.6	1.001	.206	.052
264.6	.999	.211	.032
272.5	.983	.215	-.000
276.5	.996	.213	-.011
280.0	1.010	.211	-.015
284.6	1.013	.209	-.023
288.6	1.027	.205	-.028
292.6	1.030	.202	-.038
296.6	1.033	.196	-.045
300.6	1.031	.194	-.055
304.6	1.063	.187	-.061
308.0	1.065	.178	-.070
311.1	1.023	.172	-.077
312.7	1.045	.170	-.078
314.9	1.026	.163	-.085
319.1	1.037	.151	-.098
322.9	1.063	.152	-.098
322.9	1.064	.144	-.095
326.9	1.066	.129	-.102
330.0	1.066	.126	-.110
331.0	1.055	.122	-.108
334.0	1.036	.147	-.126
339.0	.931	.081	-.105
343.0	1.036	.037	-.088
348.0	1.022	.057	-.088
354.0	.993	.019	-.062
355.2	.997	.012	-.061
357.1	1.016	.006	-.096
360.0	.987	-.016	-.043

RADIUS = .781

ANGLE	VX/V	VT/V	VR/V
-2.0	1.045	-.015	-.121
2.9	1.031	-.016	-.111
7.0	1.038	-.025	-.107
10.9	1.042	-.044	-.111
14.9	1.041	-.062	-.115
16.9	1.044	-.062	-.119
19.0	1.059	-.070	-.122
21.0	1.067	-.072	-.126
22.9	1.062	-.061	-.120
24.9	1.077	-.027	-.122
26.9	.977	-.054	-.120
28.0	.985	-.144	-.154
30.9	1.063	-.137	-.163
32.9	1.071	-.122	-.166
34.9	1.069	-.120	-.162
36.9	1.061	-.126	-.160
39.0	1.062	-.133	-.156
40.9	1.062	-.141	-.154
45.0	1.063	-.155	-.145
48.9	1.060	-.165	-.137
52.9	1.066	-.176	-.129
56.9	1.077	-.183	-.122
60.0	1.076	-.192	-.109
64.9	1.079	-.199	-.099
68.9	1.080	-.203	-.087
72.9	1.096	-.212	-.075
76.0	1.099	-.218	-.062
80.9	1.103	-.222	-.048
84.9	1.115	-.225	-.033
88.0	1.129	-.227	-.016
96.0	1.138	-.227	.017
104.9	1.146	-.226	.031
112.9	1.143	-.228	.043
121.0	1.120	-.209	.067
128.0	1.112	-.197	.088
136.0	1.101	-.182	.107
144.9	1.085	-.161	.122
153.1	1.111	-.129	.143
161.0	1.104	-.102	.152
168.0	1.110	-.076	.159
177.0	1.116	-.039	.164
180.0	1.105	-.022	.165
184.0	1.147	-.029	.165
189.2	1.120	-.011	.166
196.0	1.116	.026	.163
205.1	1.090	.060	.156
212.0	1.080	.082	.148
221.2	1.080	.109	.135
228.0	1.080	.126	.122
237.1	1.085	.146	.106
245.1	1.081	.159	.087
253.1	1.080	.172	.066
260.9	1.080	.178	.041
268.0	1.092	.186	.047
272.0	1.070	.187	.032
277.0	1.079	.188	.016
280.0	1.067	.187	0.000
284.0	1.062	.188	-.020
288.0	1.055	.186	-.030
292.0	1.044	.186	-.049
296.0	1.030	.181	-.063
301.0	1.020	.176	-.076
304.0	1.020	.169	-.089
308.0	1.037	.160	-.101
312.0	1.024	.154	-.112
316.0	1.035	.143	-.122
320.0	1.033	.132	-.128
324.9	1.035	.124	-.140
324.9	1.035	.126	-.148
328.0	1.036	.123	-.147
332.9	.938	.160	-.150
334.9	.916	.088	-.140
336.0	1.090	.016	-.133
338.9	1.079	.092	-.132
340.9	1.057	.073	-.159
343.0	1.046	.071	-.160
343.0	1.046	.071	-.160
346.9	1.039	.066	-.157
350.0	1.026	.050	-.150
354.9	1.032	.026	-.130
358.0	1.045	-.015	-.121

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
-2.9	.993	.072	-.132
0.0	.950	.055	-.121
1.0	.901	.057	-.116
4.0	.950	.041	-.110
8.9	.970	.032	-.107
12.0	.951	.006	-.102
16.0	.940	-.029	-.100
18.9	.965	-.040	-.112
19.0	.950	-.020	-.110
20.0	.953	-.046	-.114
22.0	.965	-.062	-.116
24.0	.980	-.061	-.125
26.0	.979	-.044	-.121
28.7	.967	-.025	-.123
30.0	.915	-.126	-.133
32.0	1.008	-.123	-.149
34.0	1.020	-.099	-.147
36.7	1.020	-.099	-.145
38.0	1.023	-.102	-.141
40.0	1.030	-.107	-.130
44.0	1.031	-.110	-.126
48.9	1.037	-.127	-.116
52.0	1.037	-.139	-.107
56.0	1.040	-.146	-.097
60.0	1.057	-.153	-.086
64.7	1.050	-.162	-.074
68.0	1.063	-.167	-.062
72.0	1.081	-.172	-.050
76.7	1.079	-.181	-.035
80.0	1.093	-.185	-.023
84.7	1.090	-.185	-.004
88.0	1.116	-.187	.016
96.7	1.090	-.189	.023
104.6	1.100	-.188	.045
112.6	1.080	-.183	.072
120.6	1.095	-.170	.095
128.0	1.075	-.154	.122
136.0	1.072	-.136	.139
144.6	1.066	-.116	.159
152.5	1.063	-.093	.172
160.6	1.049	-.065	.183
168.6	1.076	-.035	.190
176.6	1.075	-.005	.195
184.6	1.060	.029	.194
192.6	1.053	.041	.194
200.6	1.039	.066	.188
208.6	1.040	.063	.180
208.6	1.020	.080	.170
216.6	1.023	.116	.160
224.6	1.014	.135	.152
232.6	1.009	.154	.133
240.6	1.009	.167	.112
248.0	1.014	.179	.092
256.6	1.015	.186	.066
264.6	1.020	.194	.045
272.5	1.021	.197	.022
276.5	1.063	.196	.000
280.0	1.051	.193	.023
284.6	1.029	.192	0.000
288.6	1.026	.187	-.016
292.6	1.019	.188	-.035
296.6	1.000	.182	-.040
300.6	1.000	.179	-.064
304.6	1.006	.172	-.074
308.0	.999	.160	-.080
311.1	.990	.167	-.089
312.7	.995	.160	-.090
314.9	1.001	.150	-.099
319.1	1.000	.150	-.110
322.9	1.010	.147	-.111
322.9	1.011	.141	-.117
326.9	1.007	.131	-.125
330.0	1.009	.146	-.137
331.0	1.017	.140	-.135
334.0	.916	.065	-.107
339.0	1.030	.093	-.139
343.0	1.015	.090	-.139
348.0	1.010	.090	-.143
354.0	.995	.079	-.136
355.2	.991	.070	-.136
357.1	.993	.072	-.132
360.0	.950	.055	-.121

TABLE G-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 19

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 19
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.983	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	1.076	1.032	1.080	1.034	1.193	1.155	1.113	1.055	1.032	1.063	1.081	1.063	1.034
VTBAR =	-.022	-.000	-.017	.011	-.073	-.057	-.038	-.012	-.001	-.012	-.017	-.005	.011
VRBAR =	-.009	.022	.003	.023	-.078	-.056	-.031	.005	.021	.010	.003	.010	.023
1-WVX =	1.123	1.074	1.065	1.065	0.000	1.173	1.149	1.108	1.080	1.068	1.070	1.071	1.066
1-WX =	1.180	1.099	1.082	1.077	0.000	1.260	1.215	1.150	1.107	1.089	1.087	1.085	1.078
BBAR =	29.30	20.98	18.10	14.14	43.57	38.89	33.79	26.51	22.02	19.73	17.71	15.55	13.64
BPOS =	4.06	2.60	2.21	1.82	10.18	7.60	5.56	3.34	2.80	2.39	2.16	1.89	1.73
THETA =	90.00	72.50	105.00	90.00	25.00	25.00	92.50	87.50	72.50	105.00	105.00	92.50	90.00
BNEG =	-3.53	-2.30	-3.04	-1.59	-10.63	-8.08	-5.43	-3.09	-2.46	-2.32	-3.05	-2.33	-1.53
THETA =	340.00	272.50	332.50	335.00	7.50	357.50	0.00	340.00	272.50	332.50	332.50	332.50	335.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE G-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 19

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 19
PROPELLER DIAMETER = 6.00 FEET
JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0305	.0249	.0197	.0223	.0153	.0138	.0117	.0022
PHASE ANGLE =	267.6	276.3	268.2	262.6	255.2	255.0	241.2	186.2
RADIUS = .633								
AMPLITUDE =	.0350	.0114	.0179	.0077	.0050	.0026	.0020	.0021
PHASE ANGLE =	14.6	263.6	262.5	277.0	260.0	80.5	82.9	225.5
RADIUS = .781								
AMPLITUDE =	.0456	.0139	.0031	.0144	.0073	.0017	.0020	.0015
PHASE ANGLE =	299.9	285.1	135.3	65.1	258.5	141.5	73.0	75.1
RADIUS = .963								
AMPLITUDE =	.0470	.0247	.0156	.0110	.0065	.0074	.0042	.0053
PHASE ANGLE =	311.5	239.3	233.9	114.6	190.6	174.8	193.7	97.7

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 19
PROPELLER DIAMETER = 6.00 FEET
JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0035	.0058	.0063	.0073	.0047	.0030	.0035	.0015
PHASE ANGLE =	126.4	149.5	108.4	95.5	88.6	87.4	68.8	311.0
RADIUS = .633								
AMPLITUDE =	.0022	.0047	.0005	.0038	.0032	.0044	.0062	.0059
PHASE ANGLE =	27.5	65.3	132.0	247.1	216.8	244.1	228.4	224.0
RADIUS = .781								
AMPLITUDE =	.0037	.0019	.0041	.0032	.0041	.0033	.0014	.0019
PHASE ANGLE =	175.5	255.7	213.2	279.9	258.8	303.7	308.2	28.1
RADIUS = .963								
AMPLITUDE =	.0032	.0028	.0043	.0027	.0023	.0035	.0041	.0021
PHASE ANGLE =	88.6	149.5	228.7	275.0	261.0	248.6	239.3	311.3

TABLE G-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 19

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 76 EXP 19
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.1565	.0505	.0042	.0259	.0342	.0422	.0337	.0049
PHASE ANGLE =	243.9	286.0	302.8	260.8	254.0	253.8	243.8	106.9
RADIUS = .350								
AMPLITUDE =	.1150	.0424	.0094	.0257	.0283	.0334	.0270	.0035
PHASE ANGLE =	245.5	284.0	278.3	261.1	254.2	254.0	243.4	119.5
RADIUS = .400								
AMPLITUDE =	.0691	.0332	.0153	.0246	.0215	.0233	.0191	.0024
PHASE ANGLE =	250.2	280.8	271.3	261.7	254.6	254.4	242.7	147.7
RADIUS = .500								
AMPLITUDE =	.0165	.0198	.0215	.0197	.0114	.0078	.0070	.0024
PHASE ANGLE =	318.8	272.1	266.7	263.7	255.9	255.5	238.7	205.9
RADIUS = .600								
AMPLITUDE =	.0327	.0126	.0201	.0112	.0058	.0011	.0008	.0024
PHASE ANGLE =	16.9	263.9	263.8	270.2	258.8	79.8	118.5	223.9
RADIUS = .700								
AMPLITUDE =	.0328	.0122	.0054	.0064	.0068	.0018	.0024	.0004
PHASE ANGLE =	324.9	284.1	252.4	41.7	263.6	91.1	68.8	209.2
RADIUS = .800								
AMPLITUDE =	.0480	.0143	.0037	.0153	.0072	.0020	.0018	.0019
PHASE ANGLE =	297.9	282.4	133.9	67.7	255.9	151.7	78.4	76.4
RADIUS = .900								
AMPLITUDE =	.0514	.0184	.0064	.0147	.0061	.0049	.0019	.0040
PHASE ANGLE =	299.7	256.7	203.6	85.2	226.3	172.5	168.9	88.7
RADIUS = 1.000								
AMPLITUDE =	.0470	.0247	.0156	.0110	.0065	.0074	.0042	.0053
PHASE ANGLE =	311.5	239.3	233.9	114.6	190.6	174.8	193.7	97.7

TABLE G-4 (Continued)

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 19
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0150	.0192	.0147	.0251	.0148	.0168	.0242	.0174
PHASE ANGLE =	160.6	195.0	121.3	84.1	65.4	65.2	52.8	29.3
RADIUS = .350								
AMPLITUDE =	.0111	.0145	.0121	.0196	.0116	.0124	.0175	.0119
PHASE ANGLE =	158.9	189.1	118.4	85.7	68.8	67.3	54.0	26.8
RADIUS = .400								
AMPLITUDE =	.0069	.0095	.0091	.0132	.0080	.0074	.0101	.0058
PHASE ANGLE =	148.4	176.4	114.1	88.7	75.2	72.1	57.0	18.8
RADIUS = .500								
AMPLITUDE =	.0023	.0047	.0044	.0036	.0029	.0011	.0012	.0032
PHASE ANGLE =	88.9	118.8	103.4	109.7	111.4	158.4	177.5	240.5
RADIUS = .600								
AMPLITUDE =	.0025	.0049	.0012	.0029	.0027	.0039	.0058	.0061
PHASE ANGLE =	31.3	72.7	99.2	236.7	202.5	238.1	225.9	225.0
RADIUS = .700								
AMPLITUDE =	.0018	.0009	.0023	.0034	.0037	.0033	.0026	.0014
PHASE ANGLE =	167.2	33.6	205.6	264.8	243.8	278.6	246.7	229.9
RADIUS = .800								
AMPLITUDE =	.0039	.0022	.0043	.0032	.0042	.0033	.0014	.0023
PHASE ANGLE =	174.1	250.6	214.4	282.0	260.7	305.2	315.6	28.0
RADIUS = .900								
AMPLITUDE =	.0031	.0021	.0048	.0030	.0035	.0029	.0018	.0025
PHASE ANGLE =	146.7	209.9	221.4	283.7	265.1	285.2	272.0	8.1
RADIUS = 1.000								
AMPLITUDE =	.0032	.0028	.0043	.0027	.0023	.0035	.0041	.0021
PHASE ANGLE =	88.6	149.5	228.7	275.0	261.0	248.6	239.3	311.3

TABLE G-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 19

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 19
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2496	.0040	.0044	.0045	.0055	.0038	.0027	.0024
PHASE ANGLE =	175.7	94.4	154.7	147.1	137.9	127.2	99.6	72.8
RADIUS = .633								
AMPLITUDE =	.2115	.0100	.0060	.0063	.0045	.0026	.0028	.0012
PHASE ANGLE =	174.7	310.4	266.9	244.5	273.2	245.9	276.7	287.3
RADIUS = .781								
AMPLITUDE =	.2111	.0030	.0039	.0013	.0017	.0021	.0023	.0020
PHASE ANGLE =	174.5	109.0	207.0	254.5	298.7	239.0	312.7	249.2
RADIUS = .983								
AMPLITUDE =	.1941	.0104	.0032	.0054	.0034	.0052	.0025	.0046
PHASE ANGLE =	174.8	91.4	112.2	104.2	77.6	79.3	68.8	79.7

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 19
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0029	.0032	.0047	.0036	.0036	.0024	.0020	.0005
PHASE ANGLE =	29.6	28.2	18.1	10.7	9.8	10.2	354.6	35.4
RADIUS = .633								
AMPLITUDE =	.0014	.0010	.0003	.0010	.0025	.0025	.0032	.0022
PHASE ANGLE =	292.1	274.0	111.4	154.3	149.0	147.4	148.9	145.1
RADIUS = .781								
AMPLITUDE =	.0014	.0012	.0008	.0026	.0021	.0035	.0018	.0016
PHASE ANGLE =	325.7	197.9	121.6	151.3	174.7	165.6	208.6	190.6
RADIUS = .983								
AMPLITUDE =	.0012	.0016	.0013	.0009	.0019	.0012	.0011	.0014
PHASE ANGLE =	94.4	114.2	165.4	164.2	211.4	237.4	258.2	331.3

TABLE G-6 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 19

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 19
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.3109	.0379	.0228	.0202	.0224	.0131	.0121	.0072
PHASE ANGLE =	176.6	119.3	124.5	99.5	118.2	109.4	92.2	88.0
RADIUS = .350								
AMPLITUDE =	.2921	.0268	.0167	.0148	.0170	.0102	.0092	.0057
PHASE ANGLE =	176.4	118.1	126.8	104.0	120.4	111.5	93.2	85.6
RADIUS = .400								
AMPLITUDE =	.2702	.0145	.0100	.0089	.0109	.0068	.0058	.0040
PHASE ANGLE =	176.1	114.5	132.9	115.0	125.2	116.0	95.2	81.3
RADIUS = .500								
AMPLITUDE =	.2363	.0033	.0027	.0038	.0027	.0022	.0008	.0014
PHASE ANGLE =	175.4	335.9	211.2	194.0	169.5	149.9	115.9	58.6
RADIUS = .600								
AMPLITUDE =	.2155	.0099	.0056	.0061	.0039	.0022	.0022	.0009
PHASE ANGLE =	174.9	311.2	265.9	239.9	266.2	237.5	272.8	304.6
RADIUS = .700								
AMPLITUDE =	.2128	.0033	.0047	.0040	.0033	.0030	.0027	.0021
PHASE ANGLE =	174.6	312.7	240.4	251.1	280.2	244.8	293.5	260.0
RADIUS = .800								
AMPLITUDE =	.2102	.0042	.0038	.0007	.0014	.0017	.0021	.0017
PHASE ANGLE =	174.5	109.9	199.4	248.1	308.9	235.1	318.5	246.1
RADIUS = .900								
AMPLITUDE =	.2021	.0088	.0031	.0029	.0017	.0019	.0015	.0014
PHASE ANGLE =	174.6	101.7	153.1	99.9	60.2	90.2	22.7	92.3
RADIUS = 1.000								
AMPLITUDE =	.1941	.0104	.0032	.0054	.0034	.0052	.0025	.0046
PHASE ANGLE =	174.8	91.4	112.2	104.2	77.6	79.3	68.8	79.7

TABLE G-6 (Continued)

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 19
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0091	.0087	.0122	.0097	.0129	.0086	.0121	.0051
PHASE ANGLE =	45.0	44.6	18.2	10.7	353.2	349.8	332.7	327.5
RADIUS = .350								
AMPLITUDE =	.0071	.0070	.0099	.0079	.0100	.0067	.0088	.0036
PHASE ANGLE =	43.1	41.9	18.1	10.4	355.2	352.3	334.6	330.8
RADIUS = .400								
AMPLITUDE =	.0049	.0050	.0072	.0057	.0066	.0045	.0052	.0018
PHASE ANGLE =	39.0	37.0	18.0	10.2	359.5	357.5	339.1	340.0
RADIUS = .500								
AMPLITUDE =	.0018	.0021	.0031	.0022	.0018	.0013	.0008	.0009
PHASE ANGLE =	13.4	16.1	18.9	13.0	32.5	39.8	75.2	113.9
RADIUS = .600								
AMPLITUDE =	.0013	.0009	.0005	.0005	.0020	.0020	.0029	.0021
PHASE ANGLE =	302.5	301.8	40.8	130.5	139.7	139.4	144.1	140.4
RADIUS = .700								
AMPLITUDE =	.0015	.0010	.0006	.0021	.0023	.0033	.0022	.0020
PHASE ANGLE =	309.7	231.4	111.2	151.5	160.0	158.0	173.3	168.0
RADIUS = .800								
AMPLITUDE =	.0013	.0012	.0008	.0026	.0021	.0034	.0018	.0015
PHASE ANGLE =	330.1	190.8	125.1	151.5	178.3	167.5	215.8	196.2
RADIUS = .900								
AMPLITUDE =	.0007	.0013	.0011	.0019	.0019	.0022	.0015	.0007
PHASE ANGLE =	29.9	145.7	148.6	154.3	198.3	185.0	243.5	263.9
RADIUS = 1.000								
AMPLITUDE =	.0012	.0018	.0013	.0009	.0019	.0012	.0011	.0014
PHASE ANGLE =	94.4	114.2	165.4	164.2	211.4	237.4	258.2	331.3

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APPENDIX H

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

FOR EXPERIMENT 21

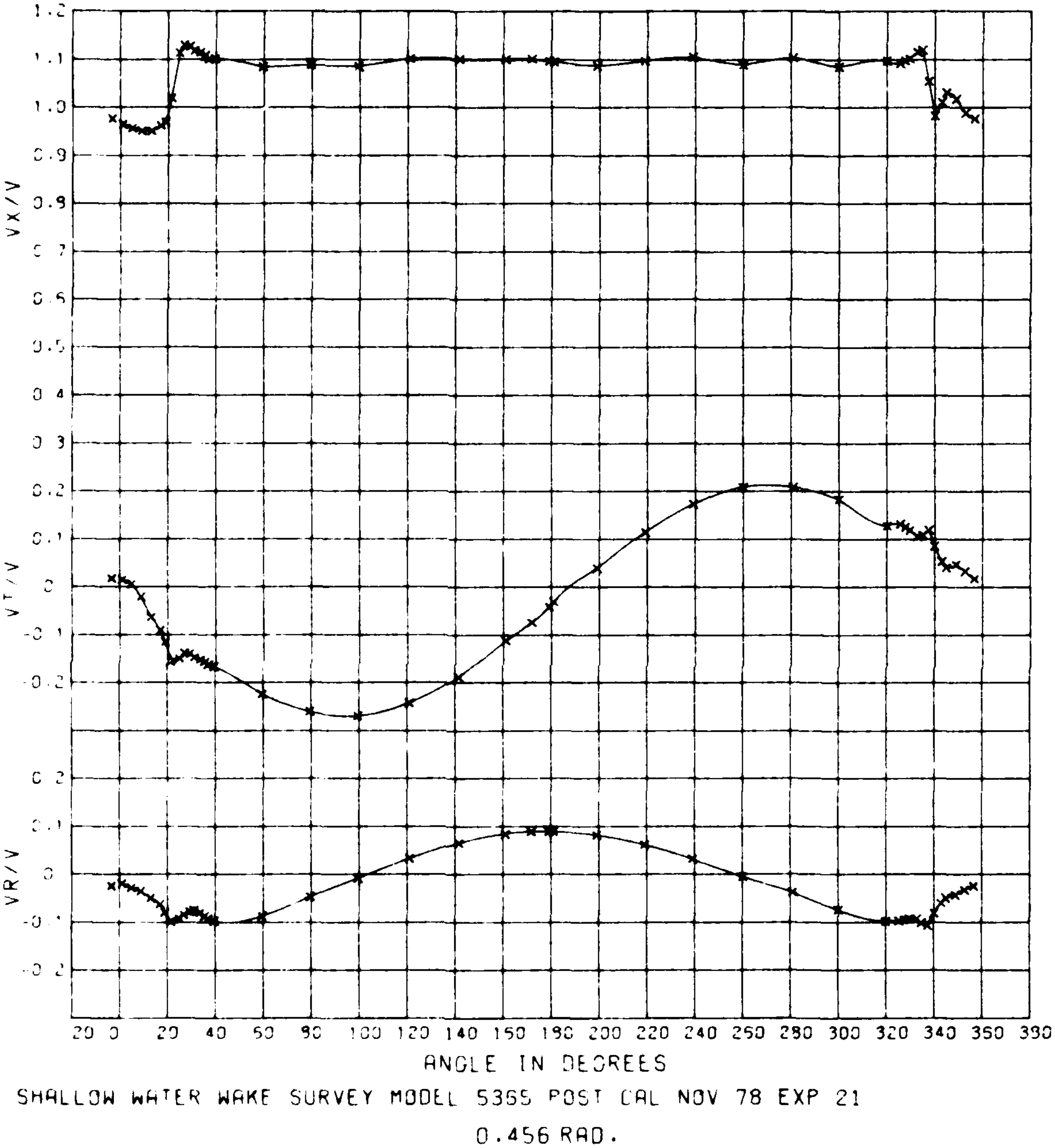


Figure H-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 21

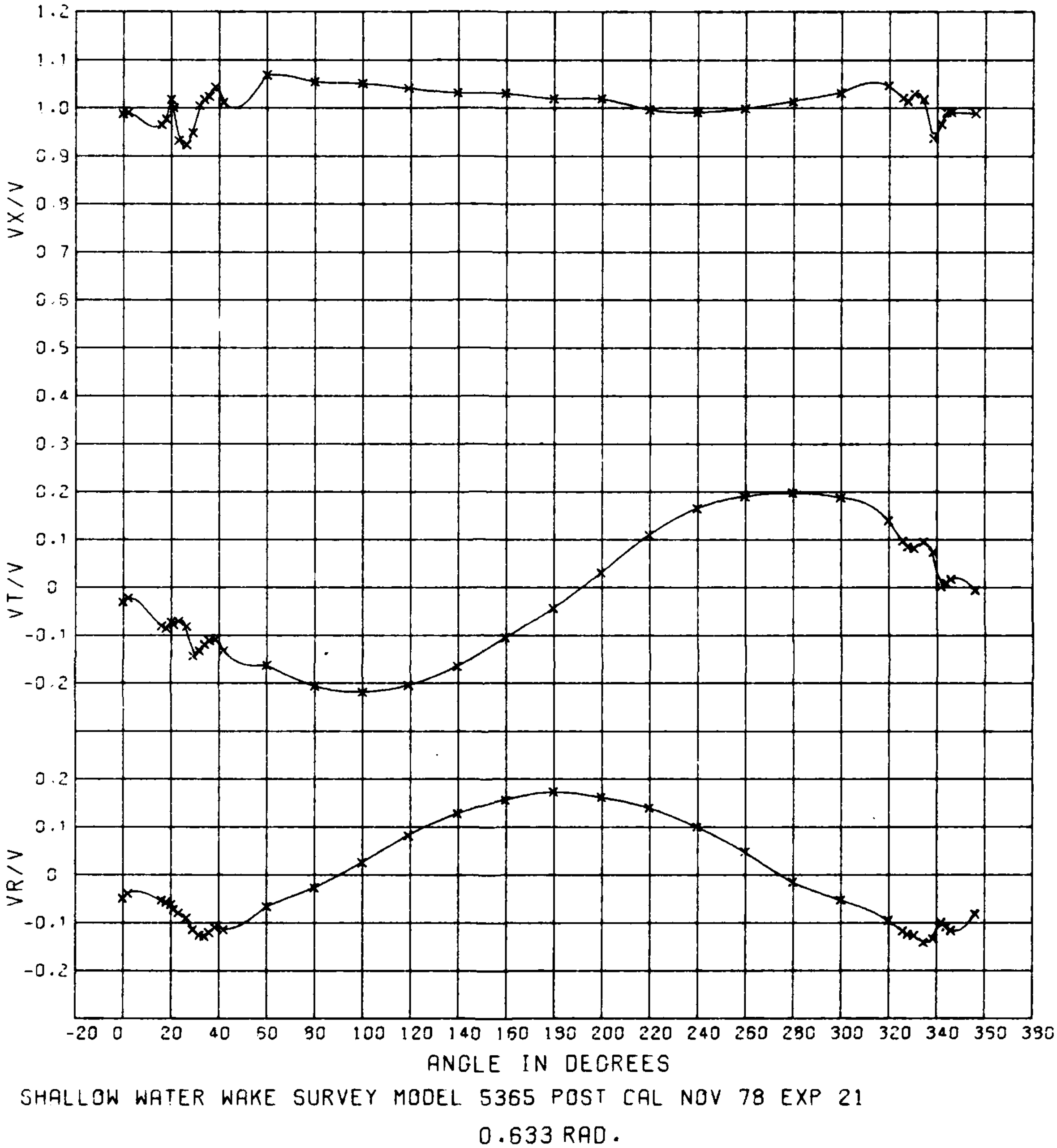


Figure H-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 21

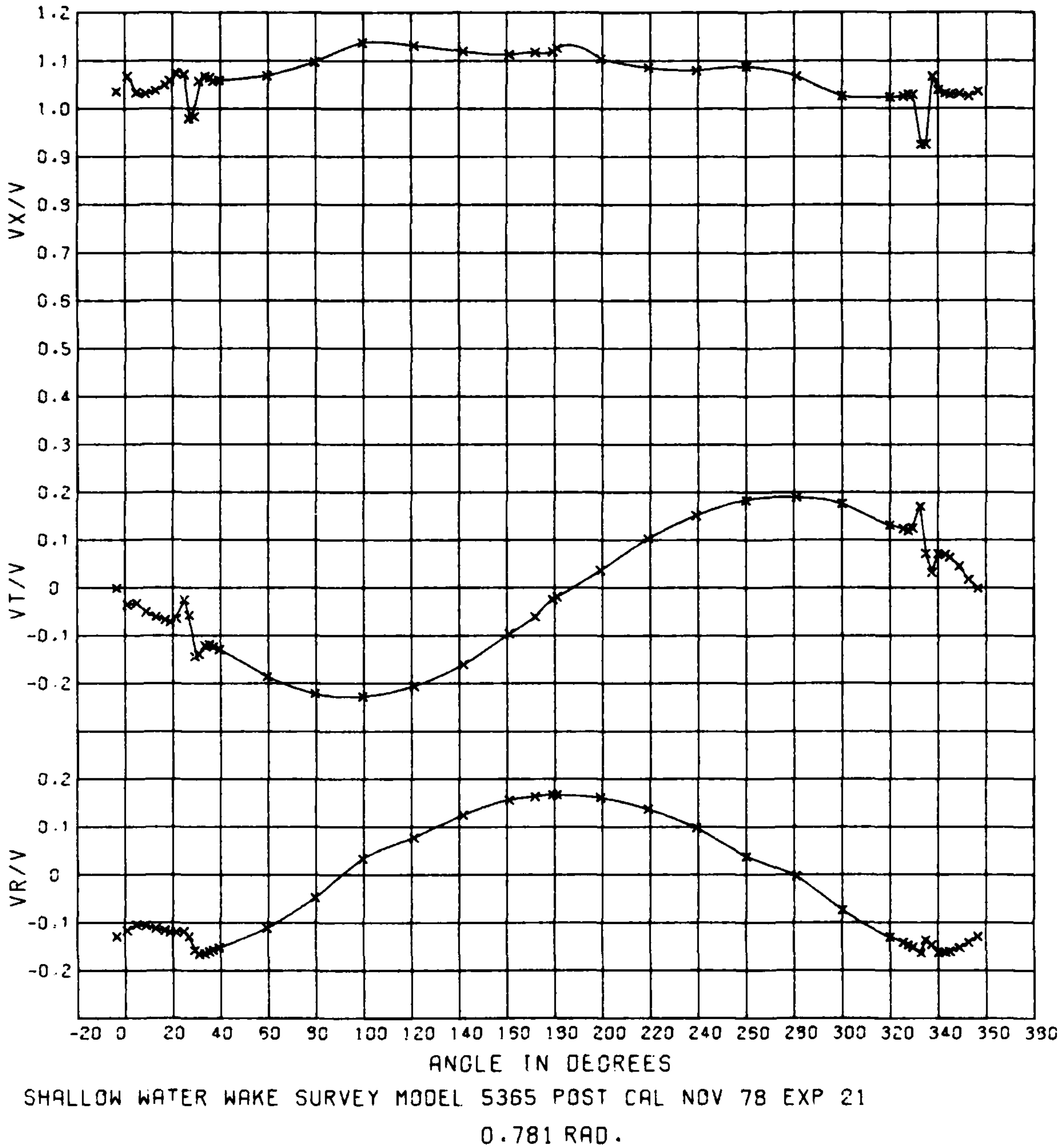


Figure H-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 21

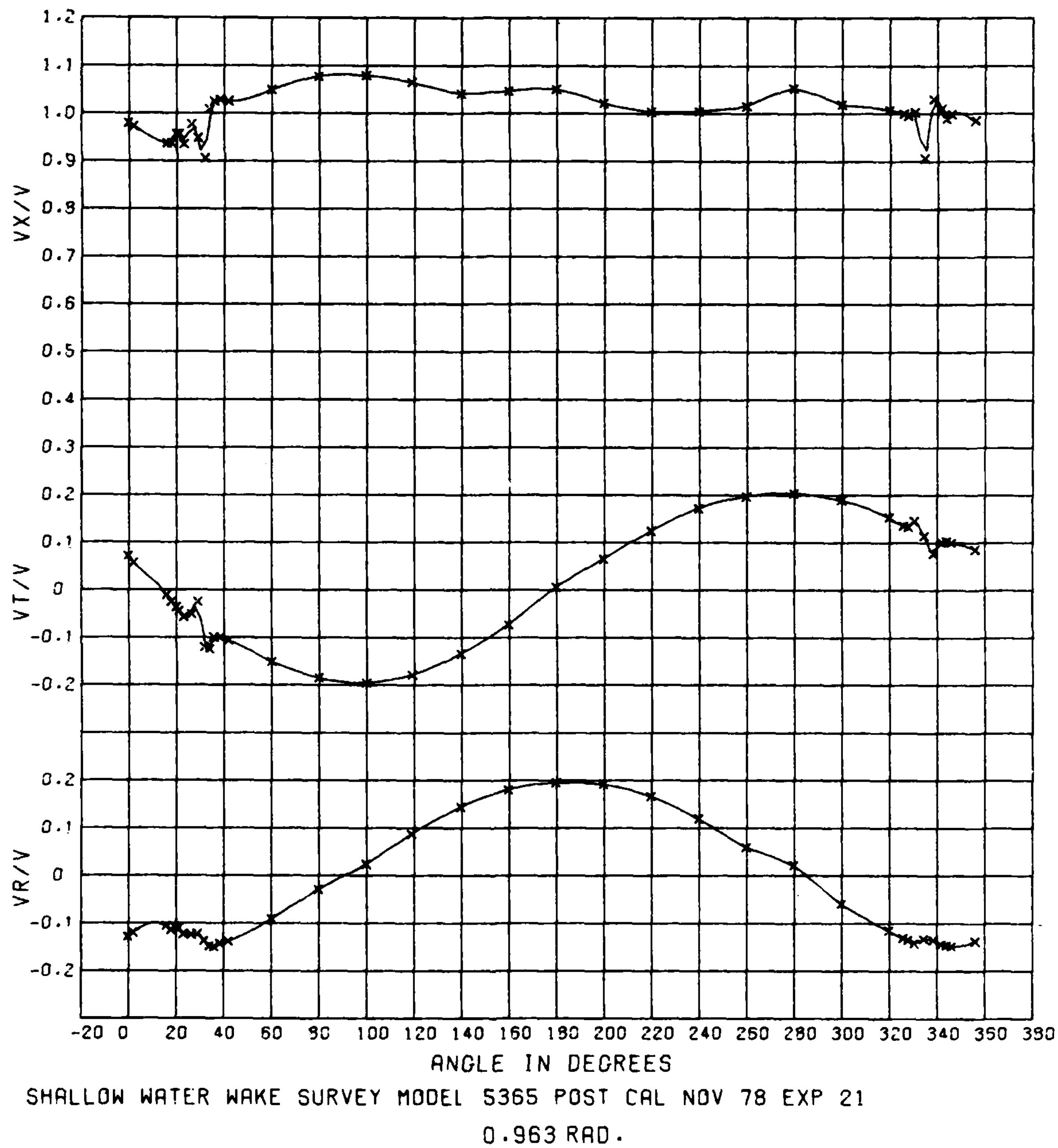


Figure H-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 21

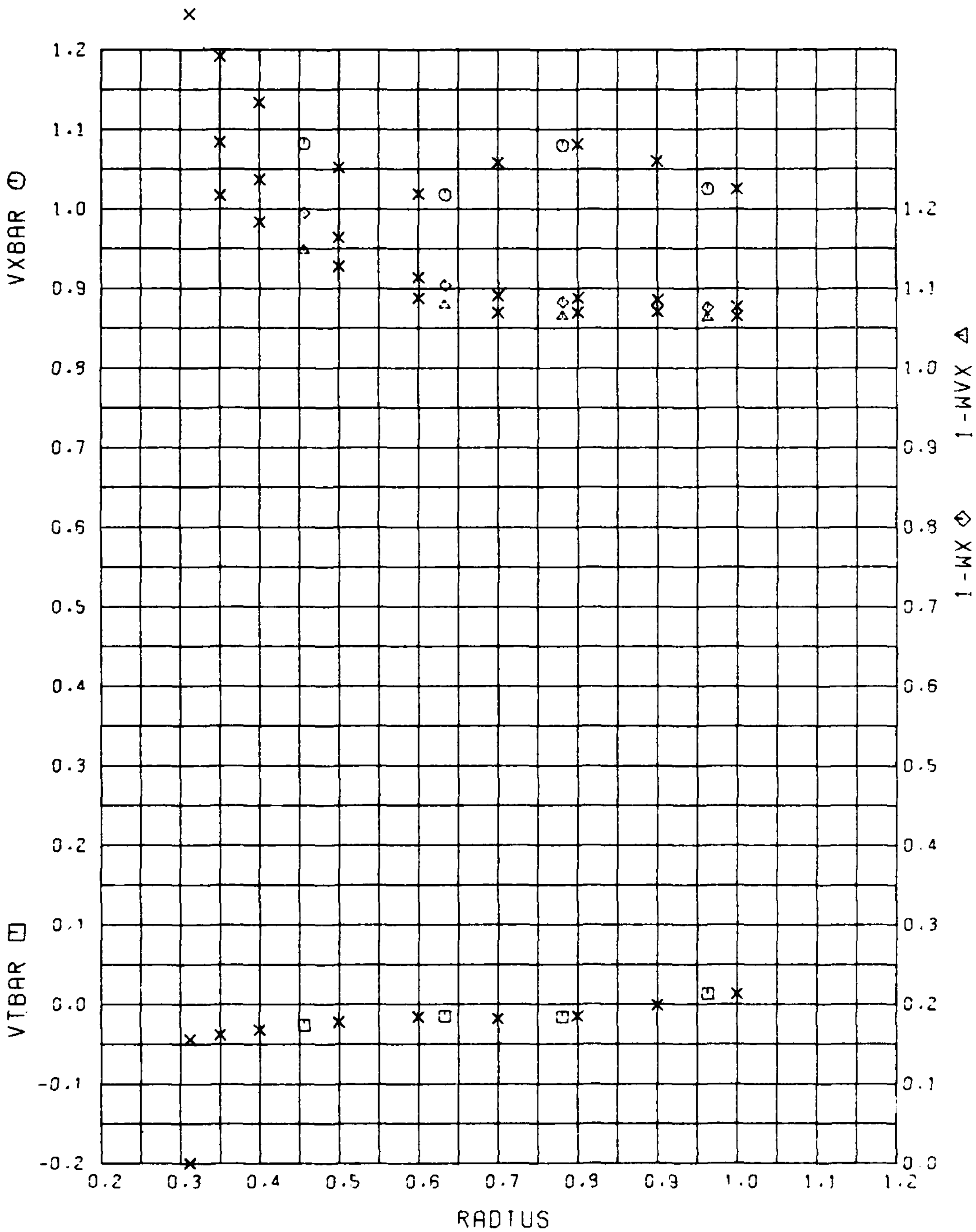


Figure H-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 21

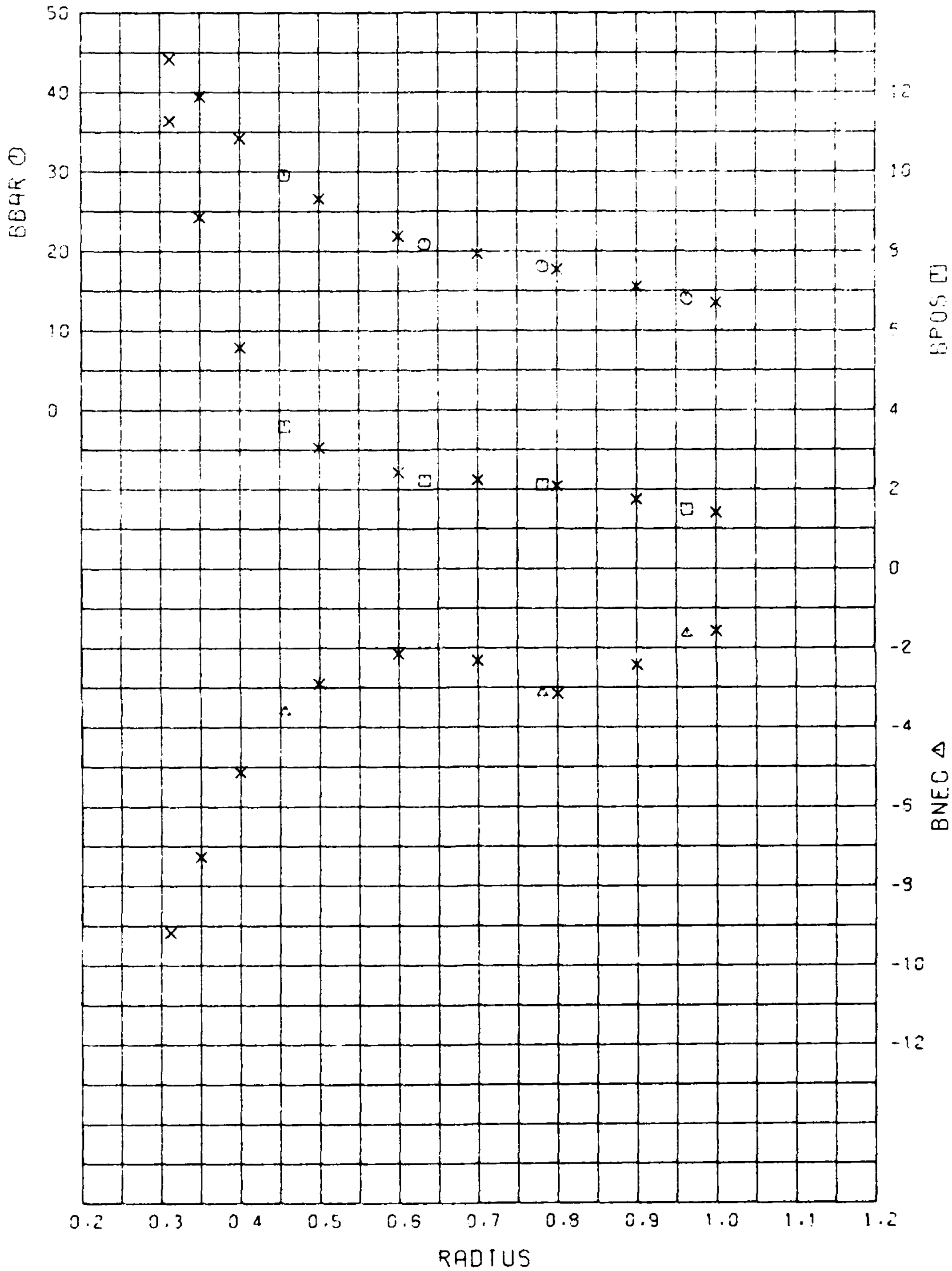


Figure H-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 21

TABLE H-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 21

RADIUS = .456

ANGLE	VX/V	VT/V	VR/V
-3.6	.977	.018	-.026
1.0	.966	.016	-.019
4.9	.957	.006	-.028
8.9	.951	-.020	-.035
13.0	.951	-.063	-.049
16.9	.963	-.091	-.062
18.9	.970	-.115	-.080
21.3	.983	-.148	-.097
22.0	1.057	-.166	-.101
24.9	1.116	-.150	-.092
26.9	1.130	-.130	-.086
28.9	1.131	-.135	-.082
29.6	1.125	-.143	-.073
31.0	1.118	-.140	-.075
33.5	1.115	-.157	-.080
35.5	1.109	-.156	-.087
37.0	1.101	-.163	-.097
39.6	1.102	-.167	-.097
59.6	1.085	-.226	-.087
79.6	1.089	-.260	-.066
99.6	1.086	-.270	-.080
121.0	1.102	-.247	.033
141.7	1.107	-.180	.065
161.0	1.101	-.112	.086
171.0	1.107	-.074	.089
179.1	1.097	-.041	.089
181.0	1.096	-.030	.089
199.2	1.087	.040	.082
219.1	1.097	.115	.062
239.2	1.105	.173	.032
260.0	1.099	.209	-.005
280.9	1.106	.259	-.037
300.0	1.085	.186	-.076
320.0	1.090	.120	-.090
325.6	1.092	.132	-.097
327.6	1.098	.126	-.099
329.5	1.102	.119	-.093
332.0	1.116	.106	-.093
334.9	1.120	.109	-.101
336.0	1.091	.170	-.100
338.0	1.019	.170	-.106
340.0	.983	.086	-.081
343.0	1.011	.056	-.060
344.9	1.031	.041	-.069
348.9	1.018	.048	-.063
352.0	.989	.036	-.032
356.6	.977	.018	-.024
361.0	.966	.016	-.019

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
-.3	.988	-.030	-.049
2.0	.990	-.022	-.039
15.9	.965	-.001	-.053
17.0	.977	-.006	-.057
19.4	1.004	-.005	-.065
20.0	1.031	-.060	-.059
21.0	1.000	-.070	-.072
23.0	.932	-.070	-.080
25.0	.967	-.050	-.077
27.0	.899	-.105	-.103
29.0	.948	-.143	-.116
31.7	1.005	-.133	-.126
33.0	1.018	-.119	-.120
35.0	1.024	-.111	-.120
37.7	1.036	-.112	-.115
39.0	1.052	-.106	-.106
41.0	1.012	-.132	-.116
59.9	1.069	-.183	-.066
79.8	1.055	-.206	-.027
99.0	1.052	-.219	.026
119.0	1.042	-.205	.002
139.6	1.031	-.165	.129
159.6	1.031	-.105	.196
179.6	1.026	-.035	.170
179.7	1.015	-.052	.176
199.6	1.020	.031	.142
219.6	.997	.110	.140
239.6	.991	.165	.100
259.7	.999	.190	.060
279.6	1.016	.190	-.015
299.7	1.031	.100	-.052
319.7	1.047	.140	-.095
325.7	1.021	.097	-.117
327.7	1.016	.009	-.126
329.7	1.030	.002	-.125
331.0	1.030	.001	-.120
333.7	1.041	.002	-.131
335.0	.999	.100	-.151
337.7	.957	.105	-.147
339.0	.917	.063	-.119
341.7	.967	.002	-.099
343.0	.991	.009	-.109
345.0	.991	.010	-.116
356.0	.989	-.006	-.002
359.7	.988	-.030	-.049

RADIUS = .781

ANGLE	VX/V	VT/V	VR/V
-3.6	1.036	-.001	-.129
1.0	1.040	-.039	-.116
4.9	1.033	-.032	-.105
8.9	1.031	-.050	-.106
13.0	1.030	-.060	-.112
16.9	1.050	-.067	-.116
18.9	1.050	-.072	-.120
21.0	1.064	-.073	-.121
22.0	1.081	-.057	-.120
24.9	1.072	-.025	-.118
26.9	.980	-.057	-.129
28.9	.985	-.142	-.157
29.6	.983	-.146	-.159
31.0	1.050	-.139	-.166
33.5	1.060	-.121	-.165
35.5	1.065	-.119	-.161
37.0	1.050	-.123	-.157
39.6	1.059	-.129	-.152
59.4	1.069	-.108	-.111
79.6	1.090	-.221	-.047
99.6	1.130	-.228	.034
121.0	1.132	-.206	.077
141.7	1.120	-.161	.125
161.0	1.113	-.096	.156
171.0	1.110	-.060	.163
179.1	1.119	-.026	.167
181.0	1.126	-.019	.147
199.2	1.106	.037	.161
219.1	1.086	.103	.137
239.2	1.080	.151	.090
260.0	1.080	.183	.030
280.9	1.060	.190	-.003
300.0	1.026	.176	-.076
320.0	1.026	.131	-.130
325.6	1.026	.174	-.141
327.6	1.030	.120	-.147
329.5	1.029	.125	-.151
332.0	.925	.170	-.166
334.9	.926	.072	-.136
336.0	1.066	.012	-.130
338.0	1.040	.053	-.155
340.0	1.039	.071	-.163
343.0	1.037	.070	-.162
344.9	1.029	.066	-.161
348.9	1.031	.046	-.152
352.0	1.026	.010	-.161
356.6	1.036	-.001	-.129
361.0	1.040	-.035	-.116

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
-.3	.980	.071	-.120
2.0	.973	.057	-.120
15.0	.937	-.011	-.106
17.0	.937	-.025	-.116
19.4	.959	-.035	-.110
20.0	.955	-.030	-.108
21.0	.957	-.044	-.111
23.0	.935	-.057	-.123
25.9	.963	-.062	-.120
27.0	.991	-.040	-.129
29.0	.968	-.025	-.122
31.7	.985	-.121	-.137
33.0	1.008	-.124	-.149
35.4	1.025	-.108	-.150
37.7	1.027	-.098	-.145
39.0	1.030	-.102	-.140
41.0	1.025	-.106	-.130
59.9	1.050	-.151	-.091
79.8	1.078	-.185	-.029
99.0	1.090	-.196	.026
119.0	1.066	-.179	.087
139.6	1.042	-.134	.144
159.6	1.047	-.073	.180
179.6	1.056	.005	.196
179.7	1.052	.007	.196
199.6	1.077	.069	.192
219.6	1.004	.124	.166
239.6	1.005	.172	.120
259.7	1.016	.197	.060
279.6	1.053	.204	.022
299.7	1.019	.189	-.059
319.7	1.008	.153	-.115
325.7	1.008	.136	-.130
327.7	.996	.133	-.136
329.7	1.009	.135	-.136
331.0	.997	.147	-.147
333.7	.988	.150	-.147
335.0	.986	.061	-.117
337.7	1.079	.059	-.179
339.0	1.027	.095	-.140
341.7	1.011	.101	-.144
343.0	.989	.103	-.140
345.0	.999	.198	-.140
356.0	.985	.086	-.137
359.7	.988	.071	-.120

TABLE H-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 21

WAKE ANALYSIS
PROGRAM VERSION OF 08/07/74

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 21
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	1.082	1.018	1.080	1.025	1.245	1.192	1.134	1.052	1.019	1.058	1.081	1.060	1.025
VTBAR =	-.026	-.015	-.016	.013	-.044	-.038	-.032	-.022	-.016	-.018	-.015	-.001	.013
VRBAR =	-.010	.021	.004	.021	-.077	-.056	-.032	.003	.020	.010	.004	.010	.021
1-WVX =	1.148	1.079	1.065	1.063	0.000	1.217	1.184	1.128	1.088	1.070	1.070	1.071	1.065
1-WX =	1.195	1.104	1.083	1.076	0.000	1.284	1.237	1.164	1.114	1.091	1.088	1.086	1.077
BBAR =	29.49	20.82	18.09	14.01	44.14	39.43	34.18	26.56	21.89	19.67	17.69	15.49	13.52
BPOS =	3.59	2.23	2.12	1.49	11.27	8.85	5.57	3.05	2.43	2.24	2.07	1.73	1.41
THETA =	110.00	95.00	102.50	92.50	25.00	25.00	25.00	87.50	70.00	100.00	102.50	100.00	92.50
BNEG =	-3.60	-1.93	-3.14	-1.63	-9.18	-7.27	-5.14	-2.91	-2.15	-2.32	-3.16	-2.43	-1.57
THETA =	340.00	337.50	332.50	335.00	5.00	5.00	5.00	340.00	337.50	332.50	332.50	332.50	335.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE H-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 21

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 21
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0277	.0230	.0202	.0225	.0168	.0131	.0106	.0045
PHASE ANGLE =	266.6	264.2	276.1	261.2	260.0	242.1	247.4	198.6
RADIUS = .633								
AMPLITUDE =	.0188	.0224	.0210	.0045	.0013	.0050	.0059	.0026
PHASE ANGLE =	331.3	232.3	239.5	234.6	96.6	42.2	63.5	90.0
RADIUS = .781								
AMPLITUDE =	.0512	.0105	.0059	.0124	.0038	.0017	.0024	.0040
PHASE ANGLE =	298.7	272.9	61.2	64.1	230.9	67.8	106.7	69.8
RADIUS = .963								
AMPLITUDE =	.0321	.0299	.0169	.0092	.0066	.0084	.0029	.0051
PHASE ANGLE =	310.1	244.2	247.8	115.0	170.5	155.7	153.2	109.5

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 21
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0053	.0058	.0051	.0059	.0057	.0043	.0026	.0009
PHASE ANGLE =	142.2	136.2	120.4	103.5	94.8	87.9	75.8	348.5
RADIUS = .633								
AMPLITUDE =	.0053	.0043	.0036	.0024	.0028	.0036	.0048	.0052
PHASE ANGLE =	118.3	117.6	81.7	13.7	312.1	258.9	224.7	201.1
RADIUS = .781								
AMPLITUDE =	.0023	.0012	.0030	.0030	.0029	.0022	.0004	.0014
PHASE ANGLE =	163.5	162.4	208.1	262.6	238.9	275.3	201.5	29.2
RADIUS = .963								
AMPLITUDE =	.0049	.0022	.0019	.0024	.0031	.0025	.0016	.0002
PHASE ANGLE =	115.4	142.8	253.4	281.3	270.9	261.4	256.3	113.2

TABLE H-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 21

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 21
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.0951	.0383	.0359	.0382	.0504	.0451	.0412	.0120
PHASE ANGLE =	255.9	320.7	358.3	274.3	259.1	236.4	243.9	215.5
RADIUS = .350								
AMPLITUDE =	.0728	.0308	.0262	.0339	.0399	.0351	.0317	.0097
PHASE ANGLE =	256.6	308.5	342.4	271.0	259.3	237.1	244.4	213.2
RADIUS = .400								
AMPLITUDE =	.0484	.0249	.0197	.0284	.0279	.0237	.0207	.0070
PHASE ANGLE =	258.9	287.9	310.8	266.5	259.6	238.7	245.3	208.5
RADIUS = .500								
AMPLITUDE =	.0172	.0234	.0226	.0180	.0100	.0066	.0044	.0029
PHASE ANGLE =	282.5	249.9	259.9	256.7	260.4	249.3	252.4	182.6
RADIUS = .600								
AMPLITUDE =	.0157	.0235	.0232	.0079	.0003	.0036	.0046	.0022
PHASE ANGLE =	331.7	233.8	242.7	243.7	218.4	33.6	60.4	105.2
RADIUS = .700								
AMPLITUDE =	.0377	.0129	.0038	.0056	.0018	.0035	.0038	.0033
PHASE ANGLE =	304.5	249.9	234.5	60.9	234.7	38.5	76.0	71.6
RADIUS = .800								
AMPLITUDE =	.0524	.0109	.0064	.0131	.0041	.0015	.0023	.0040
PHASE ANGLE =	298.3	273.8	59.9	65.6	227.4	90.0	115.8	71.5
RADIUS = .900								
AMPLITUDE =	.0462	.0186	.0023	.0121	.0052	.0048	.0026	.0045
PHASE ANGLE =	300.9	256.2	270.5	81.8	196.5	151.6	148.8	90.7
RADIUS = 1.000								
AMPLITUDE =	.0321	.0299	.0169	.0092	.0066	.0084	.0029	.0051
PHASE ANGLE =	310.1	244.2	247.8	115.0	170.5	155.7	153.2	109.5

TABLE H-4 (Continued)

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 21
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0072	.0070	.0107	.0146	.0194	.0185	.0181	.0168
PHASE ANGLE =	203.6	171.5	175.4	133.2	113.0	82.5	56.3	17.6
RADIUS = .350								
AMPLITUDE =	.0060	.0064	.0083	.0118	.0151	.0141	.0131	.0116
PHASE ANGLE =	188.1	161.0	165.0	127.9	110.4	83.1	57.5	16.8
RADIUS = .400								
AMPLITUDE =	.0052	.0060	.0062	.0086	.0101	.0090	.0075	.0058
PHASE ANGLE =	164.5	148.2	145.9	118.6	105.3	84.4	60.9	14.5
RADIUS = .500								
AMPLITUDE =	.0056	.0056	.0049	.0044	.0031	.0014	.0012	.0022
PHASE ANGLE =	130.7	129.0	103.2	86.7	75.7	100.4	178.0	209.5
RADIUS = .600								
AMPLITUDE =	.0056	.0048	.0042	.0026	.0023	.0030	.0045	.0053
PHASE ANGLE =	118.9	119.0	83.0	33.3	327.9	256.3	223.2	201.8
RADIUS = .700								
AMPLITUDE =	.0031	.0023	.0017	.0017	.0023	.0027	.0022	.0014
PHASE ANGLE =	138.7	128.9	150.5	295.8	265.9	267.1	220.0	196.2
RADIUS = .800								
AMPLITUDE =	.0023	.0011	.0032	.0032	.0030	.0021	.0002	.0018
PHASE ANGLE =	164.7	170.4	212.7	260.8	237.3	276.3	186.5	28.0
RADIUS = .900								
AMPLITUDE =	.0029	.0013	.0031	.0032	.0031	.0021	.0004	.0017
PHASE ANGLE =	136.0	165.5	230.0	263.7	247.2	271.0	281.5	28.4
RADIUS = 1.000								
AMPLITUDE =	.0049	.0022	.0019	.0024	.0031	.0025	.0016	.0002
PHASE ANGLE =	115.4	142.8	253.4	281.0	270.9	261.4	256.3	113.2

TABLE H-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 21

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 21
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2407	.0046	.0031	.0066	.0054	.0037	.0024	.0034
PHASE ANGLE =	176.5	83.6	133.0	141.9	148.2	130.4	101.8	40.3
RADIUS = .633								
AMPLITUDE =	.2084	.0124	.0065	.0059	.0042	.0026	.0023	.0006
PHASE ANGLE =	175.9	281.9	274.0	270.2	15.9	54.8	48.2	114.2
RADIUS = .781								
AMPLITUDE =	.2092	.0014	.0044	.0028	.0038	.0027	.0033	.0022
PHASE ANGLE =	175.5	92.9	266.4	256.2	259.0	245.1	272.9	280.8
RADIUS = .963								
AMPLITUDE =	.2004	.0107	.0023	.0055	.0037	.0052	.0025	.0030
PHASE ANGLE =	173.7	83.8	113.8	105.2	93.9	87.6	83.0	77.4

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 21
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0043	.0060	.0040	.0038	.0016	.0017	.0009	.0013
PHASE ANGLE =	38.5	26.4	40.8	30.6	38.3	3.7	324.2	316.5
RADIUS = .633								
AMPLITUDE =	.0010	.0004	.0007	.0015	.0010	.0007	.0020	.0028
PHASE ANGLE =	153.3	149.3	32.2	10.5	19.3	101.8	138.0	140.8
RADIUS = .781								
AMPLITUDE =	.0024	.0007	.0018	.0025	.0033	.0031	.0021	.0008
PHASE ANGLE =	278.9	280.2	202.7	165.9	177.9	163.1	178.6	157.1
RADIUS = .963								
AMPLITUDE =	.0011	.0010	.0010	.0017	.0018	.0016	.0010	.0002
PHASE ANGLE =	77.9	119.4	178.7	165.2	167.2	159.7	161.1	214.6

TABLE H-6 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 21

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 21
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2939	.0451	.0197	.0273	.0232	.0113	.0053	.0081
PHASE ANGLE =	177.0	96.7	110.6	121.6	177.7	181.7	195.1	16.1
RADIUS = .350								
AMPLITUDE =	.2775	.0321	.0144	.0207	.0174	.0085	.0036	.0065
PHASE ANGLE =	176.8	96.1	112.1	123.7	174.2	174.3	180.2	20.8
RADIUS = .400								
AMPLITUDE =	.2585	.0175	.0084	.0132	.0109	.0056	.0024	.0049
PHASE ANGLE =	176.7	94.3	115.9	128.5	166.9	159.0	145.3	28.6
RADIUS = .500								
AMPLITUDE =	.2293	.0033	.0015	.0033	.0030	.0032	.0028	.0024
PHASE ANGLE =	176.3	298.1	223.8	176.5	109.5	103.2	82.0	52.0
RADIUS = .600								
AMPLITUDE =	.2117	.0120	.0058	.0052	.0040	.0029	.0027	.0010
PHASE ANGLE =	176.0	282.5	272.6	265.0	26.7	63.1	57.3	90.6
RADIUS = .700								
AMPLITUDE =	.2097	.0054	.0059	.0048	.0026	.0012	.0018	.0015
PHASE ANGLE =	175.8	280.2	271.0	266.5	299.9	264.2	295.0	274.3
RADIUS = .800								
AMPLITUDE =	.2088	.0028	.0039	.0022	.0038	.0026	.0033	.0021
PHASE ANGLE =	175.4	93.5	264.8	250.3	254.7	242.2	271.5	282.7
RADIUS = .900								
AMPLITUDE =	.2047	.0084	.0010	.0023	.0013	.0012	.0010	.0006
PHASE ANGLE =	174.5	88.7	219.5	120.7	205.5	132.3	271.8	7.5
RADIUS = 1.000								
AMPLITUDE =	.2004	.0107	.0023	.0055	.0037	.0052	.0025	.0030
PHASE ANGLE =	173.7	83.6	113.8	105.2	93.9	87.6	83.0	77.4

TABLE H-6 (Continued)

SHALLOW WATER WAKE SURVEY MODEL 5365 POST CAL NOV 78 EXP 21
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0120	.0162	.0070	.0054	.0029	.0019	.0060	.0097
PHASE ANGLE =	17.1	20.6	47.5	64.3	140.6	345.1	308.0	318.0
RADIUS = .350								
AMPLITUDE =	.0096	.0131	.0061	.0049	.0019	.0020	.0044	.0070
PHASE ANGLE =	20.8	21.7	45.8	54.8	122.4	350.5	309.7	318.0
RADIUS = .400								
AMPLITUDE =	.0068	.0094	.0051	.0043	.0013	.0019	.0025	.0040
PHASE ANGLE =	27.3	23.4	43.5	42.7	77.8	356.7	313.1	317.8
RADIUS = .500								
AMPLITUDE =	.0028	.0038	.0031	.0034	.0018	.0014	.0003	.0004
PHASE ANGLE =	52.5	30.3	38.6	22.8	25.3	10.7	89.4	145.7
RADIUS = .600								
AMPLITUDE =	.0011	.0006	.0013	.0021	.0014	.0007	.0018	.0026
PHASE ANGLE =	120.7	73.1	33.6	11.4	16.6	59.1	133.4	140.5
RADIUS = .700								
AMPLITUDE =	.0015	.0005	.0008	.0009	.0016	.0021	.0020	.0017
PHASE ANGLE =	263.8	266.0	201.8	148.6	173.5	156.3	162.9	145.2
RADIUS = .800								
AMPLITUDE =	.0025	.0007	.0019	.0027	.0035	.0032	.0020	.0007
PHASE ANGLE =	280.6	280.4	202.3	166.7	178.0	163.6	180.5	162.2
RADIUS = .900								
AMPLITUDE =	.0011	.0001	.0017	.0027	.0032	.0028	.0015	.0003
PHASE ANGLE =	296.1	192.5	196.2	167.7	175.7	163.9	180.2	209.0
RADIUS = 1.000								
AMPLITUDE =	.0011	.0010	.0010	.0017	.0019	.0016	.0010	.0002
PHASE ANGLE =	77.9	119.4	178.7	165.2	167.2	159.7	161.1	214.6

APPENDIX I

VELOCITY COMPONENT RATIOS FOR R/V ATHENA

AND MODEL EXPERIMENTS 8 AND 21

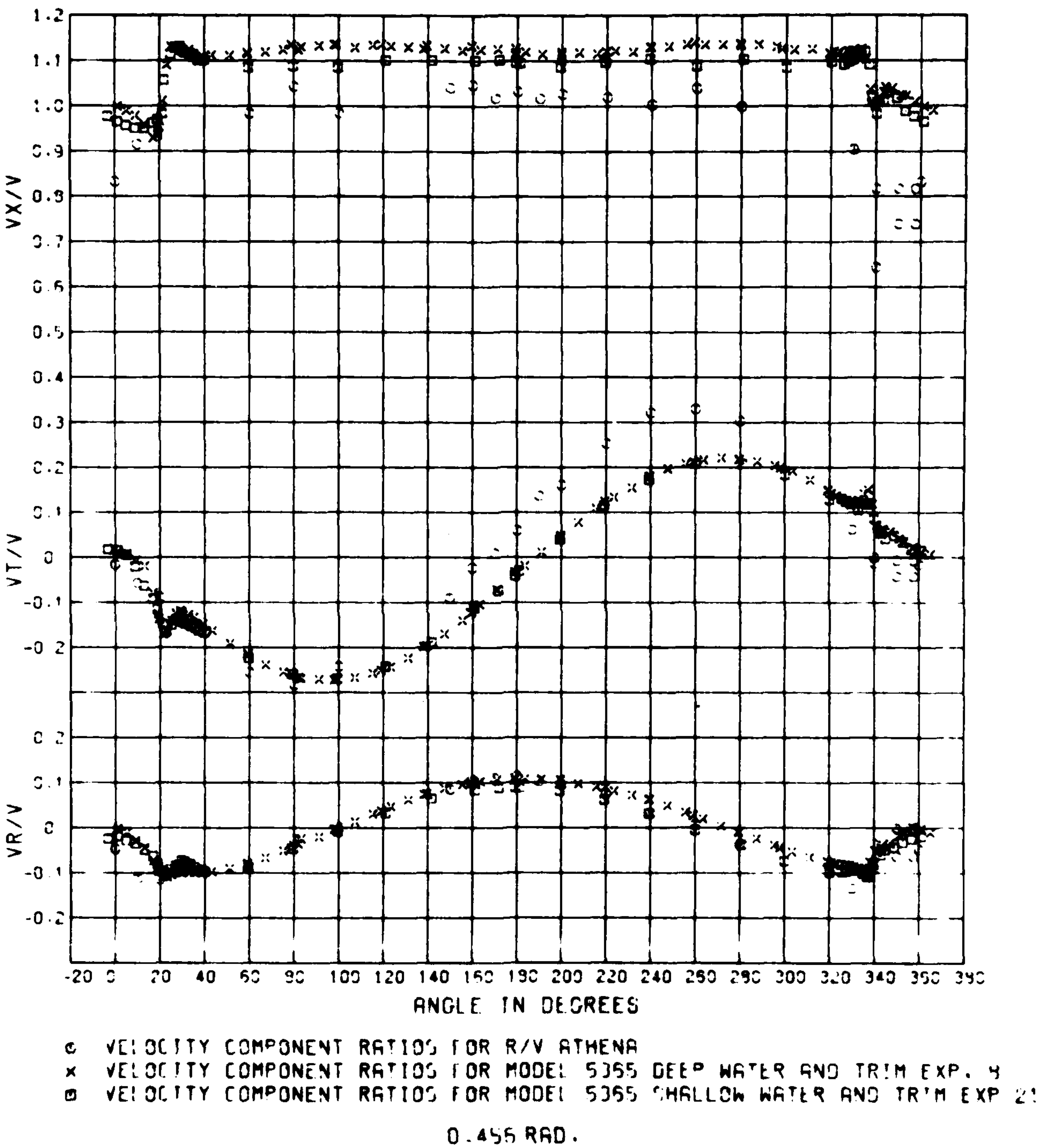


Figure I-1 - Composite Plot of Velocity Component Ratios for R/V ATHENA and Model Experiments 8 and 21 for the 0.456 Radius

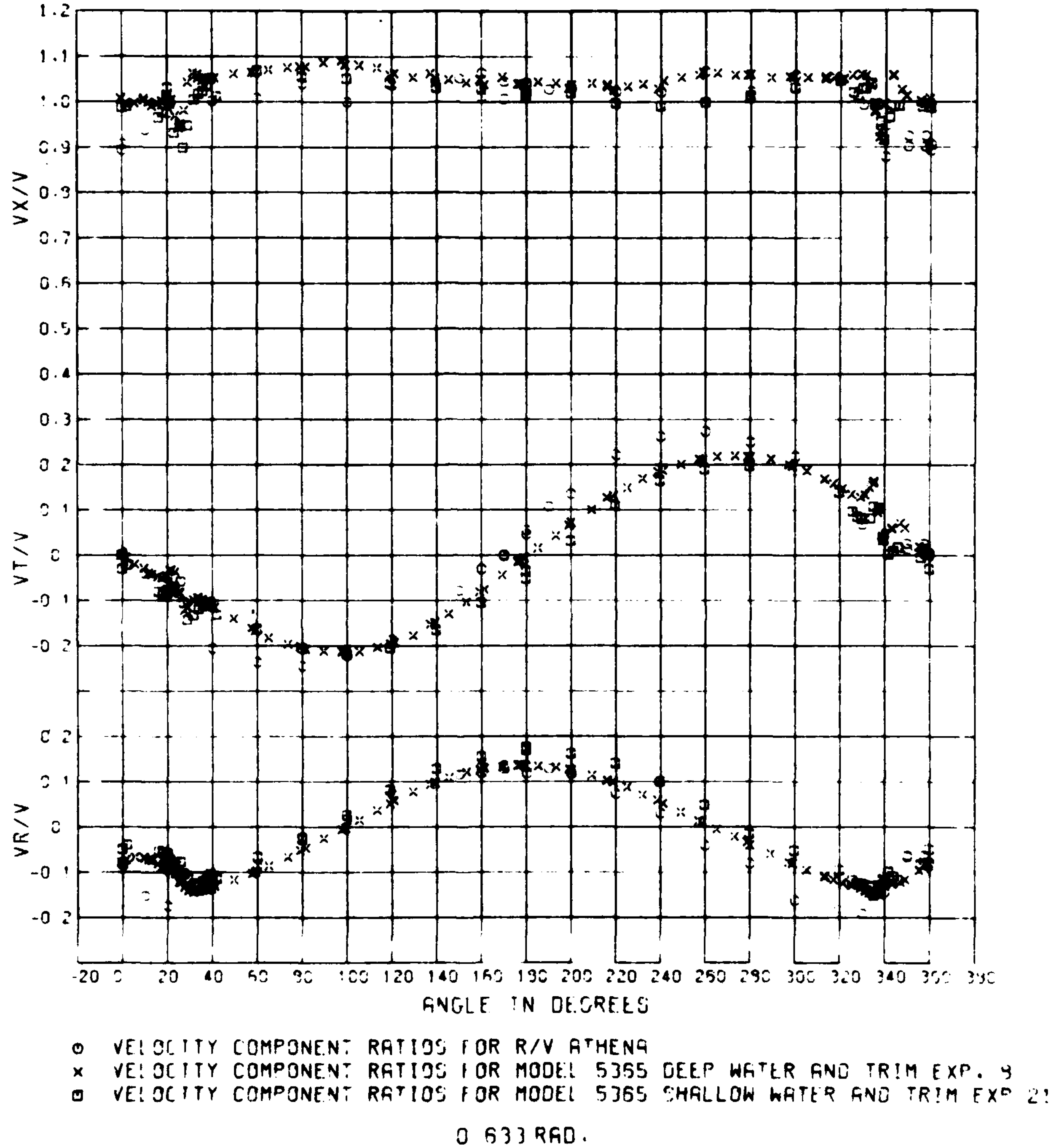
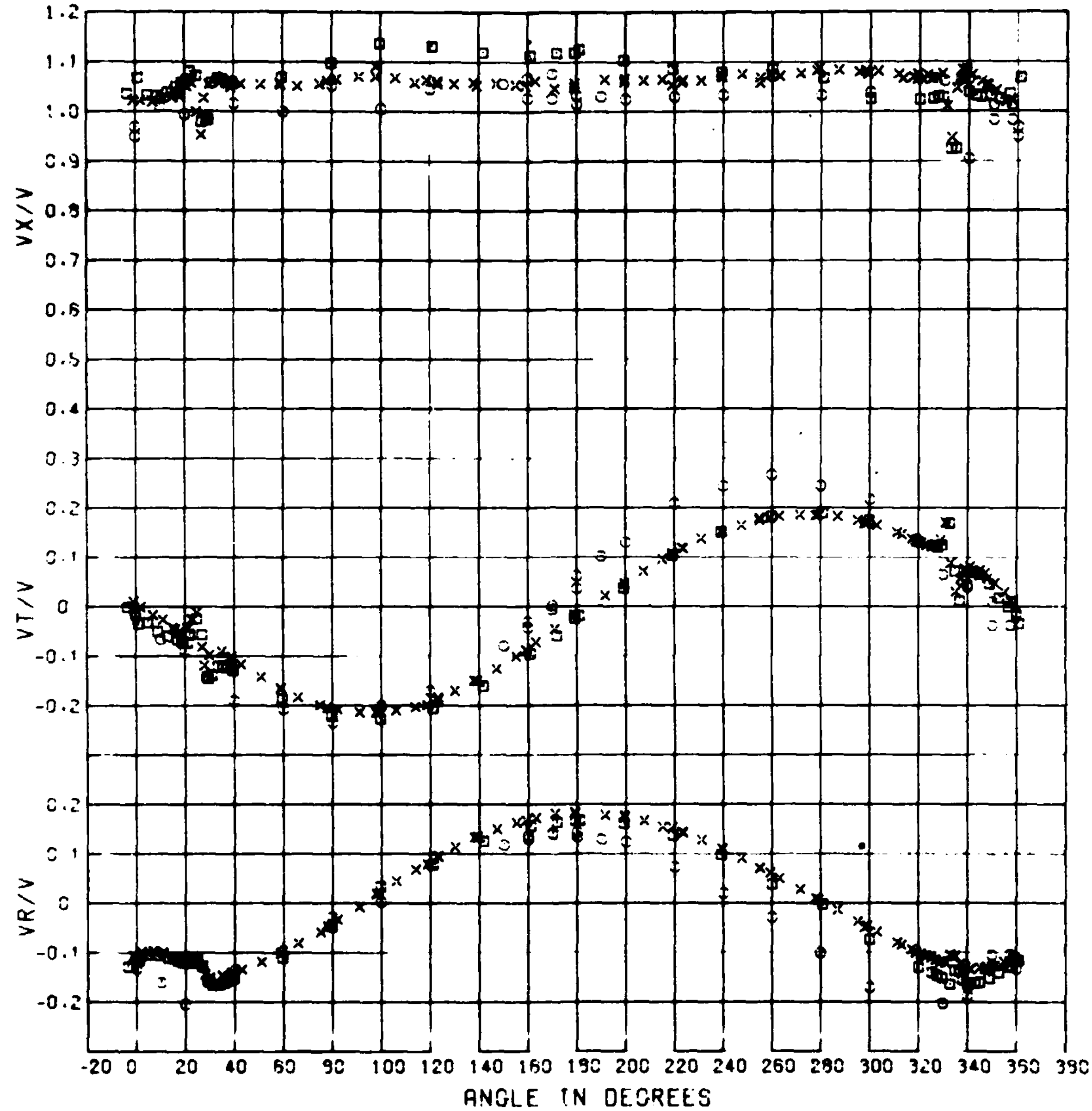


Figure I-2 - Composite Plot of Velocity Component Ratios for R/V ATHENA and Model Experiments 8 and 21 for the 0.633 Radius



⊙ VELOCITY COMPONENT RATIOS FOR R/V ATHENA
× VELOCITY COMPONENT RATIOS FOR MODEL 5365 DEEP WATER AND TRIM EXP. 8
⊡ VELOCITY COMPONENT RATIOS FOR MODEL 5365 SHALLOW WATER AND TRIM EXP 21

0.781 RAD.

Figure I-3 - Composite Plot of Velocity Component Ratios for R/V ATHENA and Model Experiments 8 and 21 for the 0.781 Radius

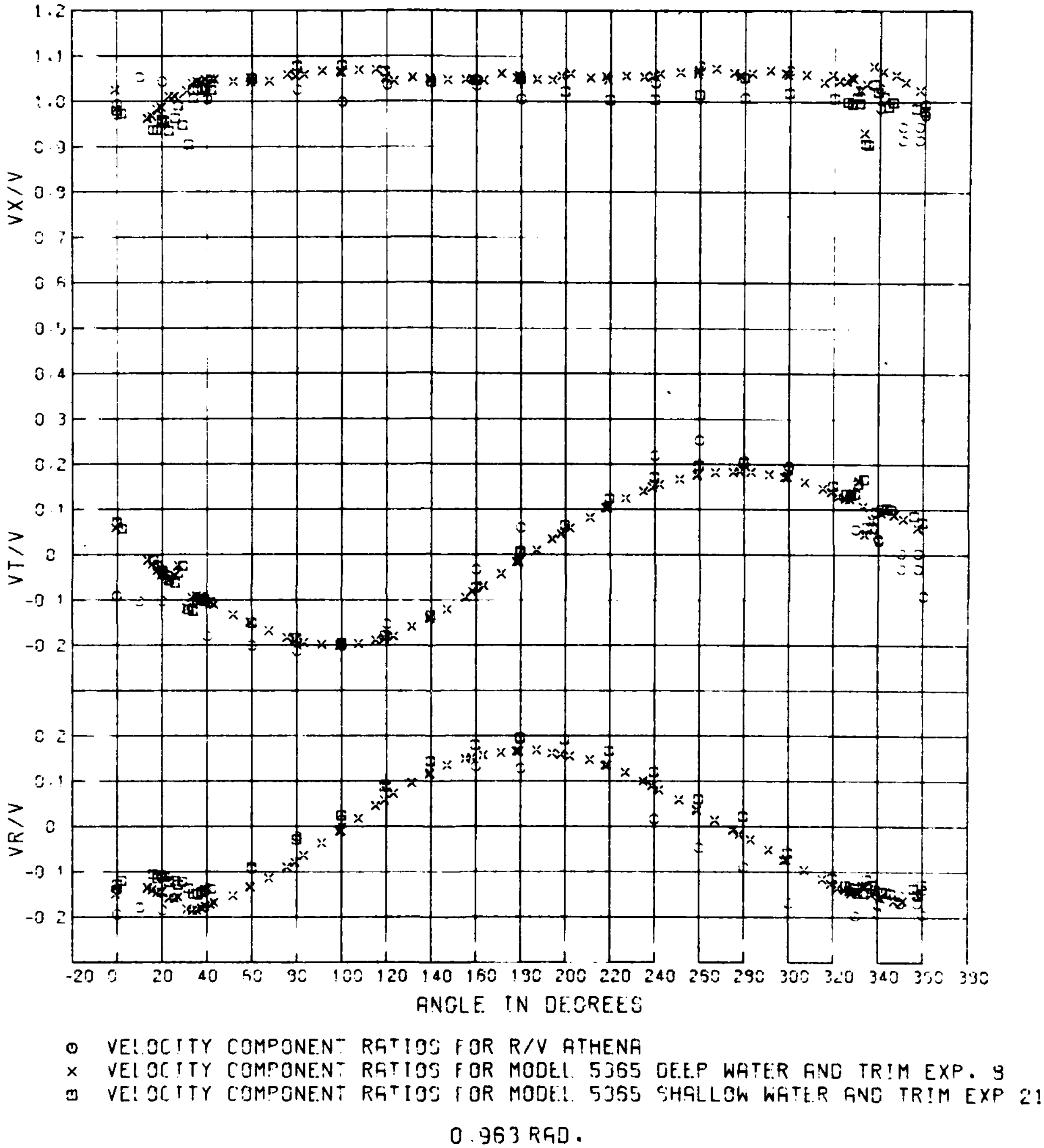


Figure I-4 - Composite Plot of Velocity Component Ratios for R/V ATHENA and Model Experiments 8 and 21 for the 0.963 Radius

TABLE I-1

INPUT DATA FOR HARMONIC ANALYSIS
OF WAKE DATA FOR R/V ATHENA

RADIUS = 0.456

ANGLE	VX/V	VT/V	VR/V
0.0	.833	-.016	-.047
10.0	.916	-.057	-.112
20.0	.953	-.088	-.115
60.0	.984	-.256	-.085
80.0	1.044	-.283	-.026
100.0	.985	-.242	.001
150.0	1.041	-.090	.085
160.0	1.047	-.023	.107
170.0	1.018	.010	.111
180.0	1.033	.060	.114
190.0	1.017	.137	.103
200.0	1.027	.161	.096
220.0	1.020	.253	.075
240.0	1.004	.322	.032
260.0	1.040	.330	.007
280.0	1.000	.304	-.037
330.0	.905	.042	-.134
340.0	.818	0.000	-.089
340.0	.644	-.013	-.035
350.0	.739	-.042	-.001
350.0	.818	-.007	-.063
357.5	.739	-.042	-.001
357.5	.818	-.007	-.063
360.0	.833	-.016	-.047

RADIUS = 0.633

ANGLE	VX/V	VT/V	VR/V
0.0	.907	.001	-.084
0.0	.894	.006	-.078
10.0	.938	-.040	-.152
20.0	.976	-.077	-.175
40.0	1.002	-.206	-.125
60.0	1.008	-.236	-.087
80.0	1.040	-.245	-.022
100.0	1.000	-.221	.017
120.0	1.038	-.187	.073
150.0	1.052	-.079	.116
160.0	1.064	-.030	.133
160.0	1.011	-.031	.119
170.0	1.045	.001	.135
170.0	1.007	-.002	.128
180.0	1.042	.046	.133
180.0	1.021	.055	.118
190.0	1.027	.107	.128
200.0	1.031	.136	.117
220.0	1.024	.222	.073
240.0	1.022	.262	.030
260.0	1.067	.274	-.041
280.0	1.023	.250	-.081
300.0	1.059	.219	-.162
330.0	.993	.068	-.191
340.0	.880	.034	-.121
340.0	.949	.047	-.144
350.0	.925	.025	-.063
350.0	.902	.014	-.066
357.5	.925	.025	-.063
357.5	.902	.014	-.066
360.0	.894	.006	-.078
360.0	.907	.001	-.084

RADIUS = 0.781

ANGLE	VX/V	VT/V	VR/V
0.0	.950	-.013	-.112
0.0	.969	-.019	-.133
10.0	1.010	-.066	-.161
20.0	.994	-.089	-.205
40.0	1.016	-.190	-.136
60.0	1.000	-.208	-.096
80.0	1.052	-.235	-.028
100.0	1.006	-.201	.003
120.0	1.045	-.171	.078
150.0	1.056	-.080	.118
160.0	1.027	-.043	.130
160.0	1.068	-.031	.136
170.0	1.026	-.007	.140
170.0	1.075	.001	.142
180.0	1.015	.062	.134
180.0	1.033	.036	.144
190.0	1.030	.101	.129
200.0	1.025	.130	.124
220.0	1.030	.209	.073
240.0	1.033	.244	.020
260.0	1.072	.267	-.029
280.0	1.033	.245	-.101
300.0	1.039	.218	-.171
330.0	1.061	.065	-.203
340.0	1.065	.045	-.167
340.0	.905	.040	-.188
350.0	.983	.010	-.127
350.0	1.013	-.038	-.105
357.5	.983	.010	-.127
357.5	1.013	-.038	-.105
360.0	.969	-.019	-.133
360.0	.950	-.013	-.112

RADIUS = 0.963

ANGLE	VX/V	VT/V	VR/V
0.0	.971	-.091	-.139
0.0	.994	-.091	-.194
10.0	1.053	-.103	-.179
20.0	1.044	-.102	-.184
40.0	1.005	-.180	-.136
60.0	1.008	-.201	-.093
80.0	1.026	-.213	-.022
100.0	.999	-.201	.013
120.0	1.036	-.153	.089
160.0	1.035	-.033	.132
180.0	1.006	.060	.128
240.0	1.041	.219	.016
260.0	1.079	.253	-.047
280.0	1.009	.208	-.090
300.0	1.069	.196	-.165
330.0	1.026	.056	-.197
340.0	1.030	.031	-.191
340.0	.987	.035	-.171
350.0	.945	-.031	-.169
350.0	.916	.003	-.157
357.5	.945	-.031	-.169
357.5	.916	.003	-.157
360.0	.994	-.091	-.194

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1. DTNSRDC REPORTS, A FORMAL SERIES, CONTAIN INFORMATION OF PERMANENT TECHNICAL VALUE. THEY CARRY A CONSECUTIVE NUMERICAL IDENTIFICATION REGARDLESS OF THEIR CLASSIFICATION OR THE ORIGINATING DEPARTMENT.

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3. TECHNICAL MEMORANDA, AN INFORMAL SERIES, CONTAIN TECHNICAL DOCUMENTATION OF LIMITED USE AND INTEREST. THEY ARE PRIMARILY WORKING PAPERS INTENDED FOR INTERNAL USE. THEY CARRY AN IDENTIFYING NUMBER WHICH INDICATES THEIR TYPE AND THE NUMERICAL CODE OF THE ORIGINATING DEPARTMENT. ANY DISTRIBUTION OUTSIDE DTNSRDC MUST BE APPROVED BY THE HEAD OF THE ORIGINATING DEPARTMENT ON A CASE-BY-CASE BASIS.